September 30, 1957 50 Cents

AVIATION WEEK

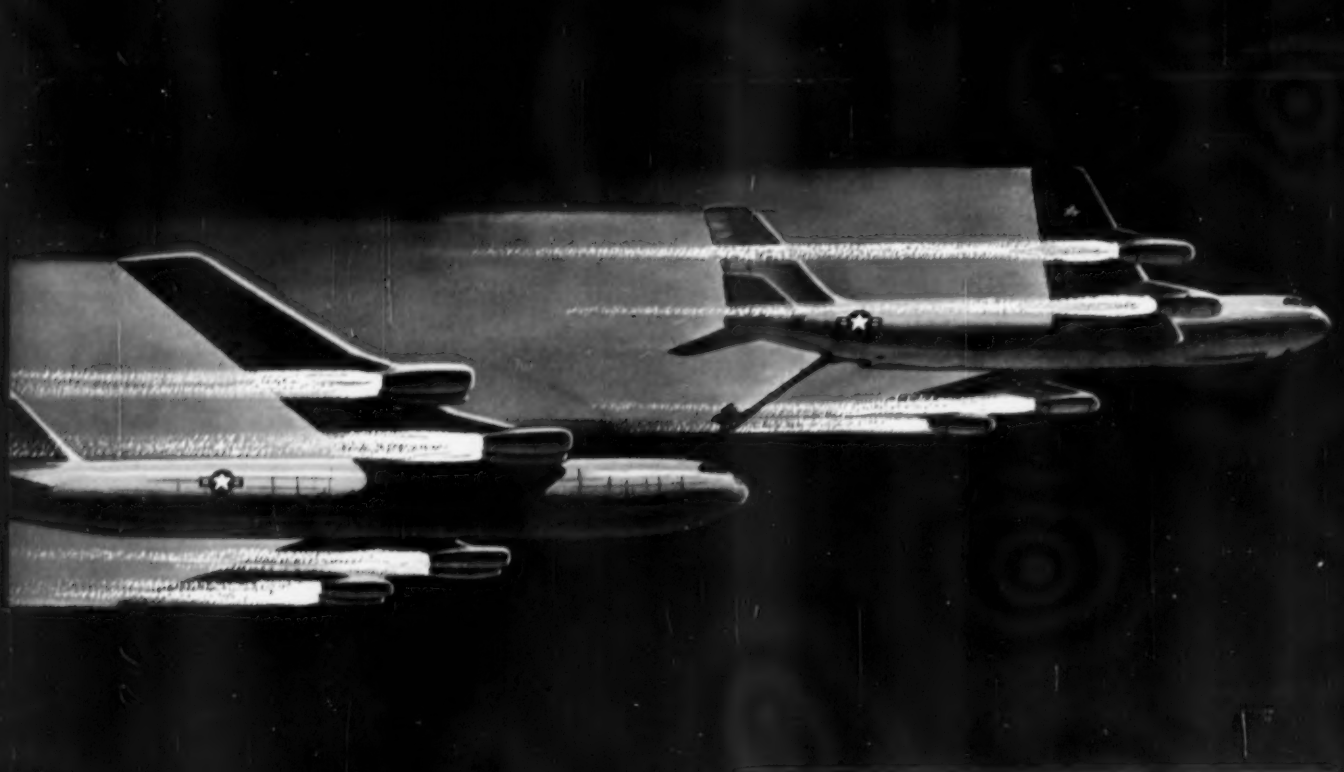
A McGRAW-HILL PUBLICATION

English Electric P.1B Interceptor Design

•

High Temperature Avionic Components

Allison Turboprop Test Fleet



HIGH LEVEL DELIVERY

You're looking at a big forward step in American air power. The Boeing KC-135 jet tanker-transport shown refueling a B-52 goes *up* and *after* the supersonic bomber to deliver a fuel load. No longer will the B-52 have to *come down* and *slow down* to get its fuel. This means faster, safer, more efficient refueling and longer range operation for the B-52.

Foote Bros. has provided, and is providing for these aircraft, important Precision Assemblies for surface control mechanisms, as well as Precision Aircraft Quality Gears for the engines that power them.

We are proud of the confidence placed in us by the aviation industry, and prouder still of the performance of Foote Bros. components in these and other aircraft.

For design, development, and/or production of Precision Aircraft Engine Type Gearing, actuators and power transmission, come to Foote Bros. first. It will pay you dividends.

this trademark stands for the finest industrial gearing made

FOOTE BROS.

Better Power Transmission Through Better Gears

FOOTE BROS. GEAR AND MACHINE CORPORATION
4545 South Western Boulevard, Chicago 9, Illinois

PANAGRA PROVES, PRAISES Goodyear Skid Warning System

In brutal, conclusive tests of new system, airliners stop shorter, safer *in thin air!*

In exhaustive tests of staggering proportions, Pan American Grace Airways, Inc., has proved the remarkable efficiency of the revolutionary new Skid Warning System* developed by the Goodyear Aviation Products Division.

Equipping Douglas DC-6B's first for stateside tests, and then a DC-7B for grueling high-speed rejected take-offs and landings at Quito, Ecuador, and on difficult runway surfaces in La Paz, Bolivia – located at 9,200′ and 13,404′ above sea level respectively – PANAGRA has made a revealing report of the success of the new Goodyear Skid Warning equipment:

(1) *Not a single tire was blown throughout the entire 32 stop test* which included landings at speeds up to 198 mph on a loose rock and sand runway surface.

(2) Incredibly short landing distances were achieved through use of this equipment – while landing speeds encountered were estimated at 195 mph on unpaved surfaces.

As a result, PANAGRA is satisfied it can now receive CAA approval for operating Skid Warning-equipped 7B's on fields located where optimum braking is both necessary and extremely difficult.

WRITE FOR INFORMATION on the one system that requires no brake modification, can be easily installed on any existing brake or braking system, allows pilot full control of his braking at all times! Address: Skid Warning, Goodyear, Aviation Products Division, Akron 16, Ohio, or Los Angeles 54, California.

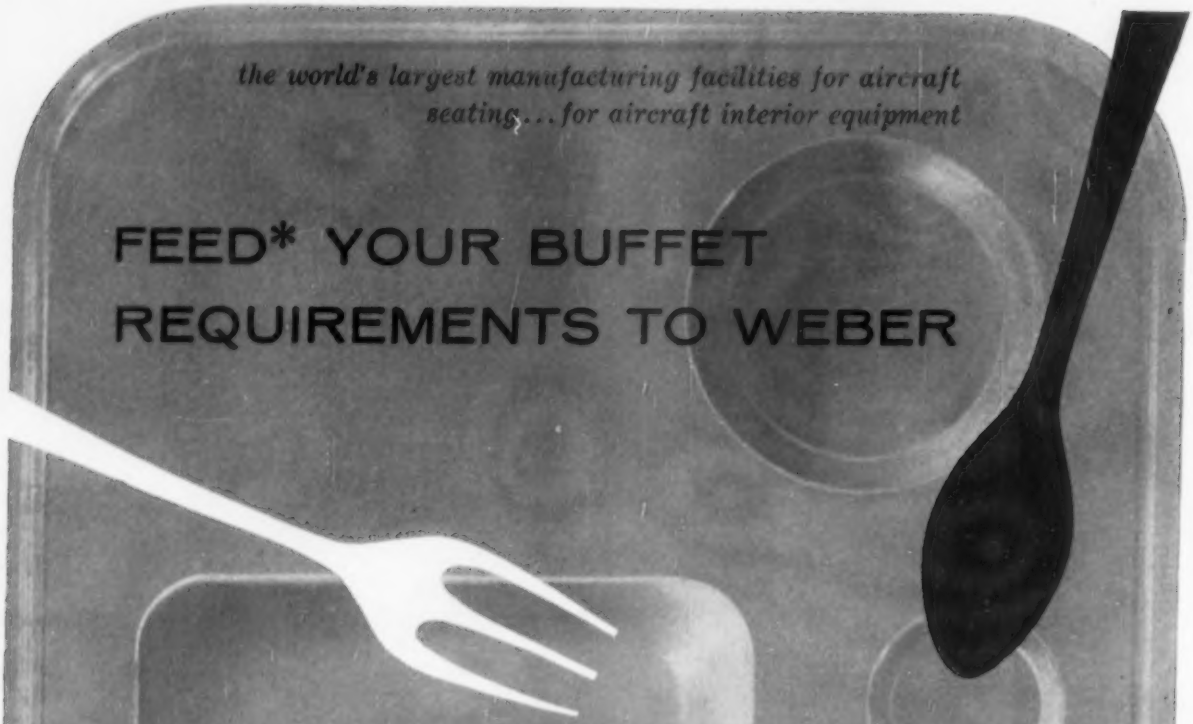
*Patents pending

GOODYEAR AVIATION PRODUCTS

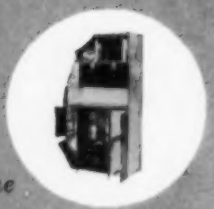
More Aircraft Land on Goodyear Tires, Wheels and Brakes Than On Any Other Kind

the world's largest manufacturing facilities for aircraft seating... for aircraft interior equipment

FEED* YOUR BUFFET REQUIREMENTS TO WEBER



Behind the gleaming beauty of the modern Airline Buffet lie complexities that determine its efficiency. Quick reliable food heating, beverage cooling, ample storage capacity, easy operation, disposal facilities, and much, much more.



More... yes. For also behind every Weber buffet are design competence... weight-conscious engineering... efficient integrated facilities for quantity fabrication. Plus... the most reliable, longest established company in the field, daily staking its reputation on your lasting satisfaction.

No food-service-aloft problems need trouble you... feed them to Weber.

a World of experience in: Pilot and crew seats, ejection seats, passenger seats, buffets and lavatory units.

*FEED — to furnish the essentials; to supply with cue-lines.

WEBER AIRCRAFT CORPORATION

a subsidiary of Weber Showcase and Fixture Company, Inc.

2620 ONTARIO STREET, BURBANK, CALIFORNIA

AVIATION CALENDAR

Sept. 30-Oct. 5—National Aeronautic Meeting, Aircraft Production Forum & Aircraft Engineering Display, Society of Automotive Engineers, Hotel Ambassador, Los Angeles.

Sept. 30-Oct. 5—International Conference on Rocket and Earth Satellite Programs for the International Geophysical Year. For invitation write: Director of Information, U. S. National Committee, IGY, National Academy of Science, 2101 Constitution Ave., N.W., Wash., D. C.

Oct. 1-3—International Conference on Lubrication and Wear, Institution of Mechanical Engineers, London, England.

Oct. 1-3—National Infrared Information Symposium, Huntington-Sheraton Hotel, Pasadena, Calif. (By invitation only). For details, write: Arthur J. Laufer, national executive chairman, Infrared Information Symposia, 1030 E. Green St., Pasadena.

Oct. 2-4—National Airports Conference, University of Oklahoma, Norman, Okla.

Oct. 2-4—Tenth Annual Meeting and Forum, National Business Aircraft Assn., Cosmopolitan Hotel, Denver, Colo.

Oct. 4—First Annual Awards Banquet, Society of Experimental Test Pilots, Beverly-Hilton Hotel, Los Angeles.

Oct. 6-8—International Northwest Aviation Council, 21st annual convention, Palliser Hotel, Calgary, Alberta, Canada.

Oct. 7-9—13th Annual National Electronics Conference, Hotel Sherman, Chicago, Ill.

Oct. 7-9—Fourth Annual Lubrication Conference, sponsored by American Society of Lubrication Engineers and American Society of Mechanical Engineers, Royal York Hotel, Toronto, Canada.

Oct. 7-10—Triennial Inspection, Lewis Flight Propulsion Laboratory, Cleveland.

Oct. 7-12—Eighth Annual Congress, International Astronautical Federation, Barcelona, Spain. For details write: IAF, 35 Lowell Rd., Concord, Mass.

Oct. 8—Tenth Annual Airport Development and Operations Conference, Onondaga Hotel, Syracuse, N. Y.

(Continued on page 6)

AVIATION WEEK • SEPTEMBER 30, 1957

Vol. 67, No. 13

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948), Founder. Executive, Editorial, Advertising and Subscription offices: **McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Publication offices, 99-129 North Broadway, Albany 1, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice President, Publication Division; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator.

Subscriptions are solicited only from persons who have a commercial or professional interest in aviation. Position and company connection must be indicated on subscription order.

Single copies 50¢. Subscription rates—United States and possessions $6 a year, Canada $8 a year.

Second class mail privileges authorized at Albany 1, N. Y. Printed in U. S. A. ©Copyright 1957 by McGraw-Hill Publishing Co., Inc. All rights reserved. Cable Address: "McGraw-Hill New York." Publications combined with AVIATION WEEK are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.

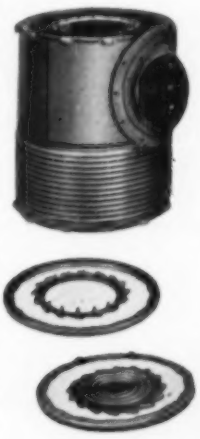
Subscription: Address correspondence and change of address to Subscription Manager, Aviation Week, 330 West 42nd Street, New York 36, N. Y. Subscribers should give old as well as new address including postal zone number, when changing address. Enclose recent address label if possible. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Aviation Week, 330 West 42nd Street, New York 36, N. Y.

Photo courtesy of Herman Nelson Division, American Air Filter Company

HEAT'S ON...

and ready to scramble!



The Convair F102A scrambles to intercepting altitude at a moment's notice . . . thanks to the reliable Herman Nelson MC-1 Portable Heater which supplies finely controlled quantities of warm and tempered air for pre-flight servicing.

Heart of the MC-1 is this Heat Exchanger unit, precision fabricated by Lavelle to Herman Nelson drawings and specifications. Proved under test to exceed 1,000 hours of continuous operation, the Heat Exchanger assures dependable heat to speed take-off when the F102A is on "alert".

To speed production and on-time delivery, the MC-1 Heat Exchanger is fabricated with special tools, custom designed and built by Lavelle. During a five-year period, frequent review of processing and tooling has enabled Lavelle to improve quality . . . *without* increasing cost to customer, despite rising labor and material costs.

For components requiring precision fabrication, quality workmanship, dependable delivery . . . at reasonable cost . . . contact Lavelle.

Write for illustrated brochure describing Lavelle's services in detail.

Lavelle

LAVELLE AIRCRAFT CORPORATION • NEWTOWN, BUCKS COUNTY, PA.

Between Philadelphia, Pa., and Trenton, N. J.

New **VAN TRAILER** by Craig
houses all this equipment . . . with room to spare!

There's plenty of room inside the new insulated Craig Van Trailer LM-105! With its big 5,000 pound payload and roomy 575 cubic foot interior, this rugged van trailer can house 12 standard 6-foot racks, fully loaded with electronic equipment — and still allow ample space for operation and maintenance.

Whatever the load — a complete electronic system, test equipment, mobile maintenance shop, or you-name it — your equipment arrives quickly and safely in the LM-105. This versatile van trailer meets Government specifications for world-wide, all-weather use.

Quick facts about the LM-105:

WEIGHT: Approximately 4,000 pounds including dolly.

PAYLOAD: 5,000 pounds.

DIMENSIONS: (Inside) 140 inches long, 90 inches wide, 79 inches high.

INSULATION: overall shelter has U-Factor of 0.30.

FEATURES INCLUDE: aluminum-faced honeycomb panel construction; lighting system; power distribution box; cable entry ports; stairs; jacks for levelling; and a quickly detachable dolly with coil spring and torsion bar suspension, air-over-hydraulic brakes, and single beam towing tongue.

ACCESSORY EQUIPMENT AVAILABLE: includes air conditioner, heater, workbench, racks, cabinets, spare parts containers, etc.

AIR TRANSPORTABLE: By C-119 or larger cargo aircraft.

ELECTRONIC INSTALLATION: Craig provides complete layout and installation of equipment including wiring and component check-out.

Van Trailer LM-105, front view, with jacks in position.

For further information, write Craig today!

Craig SYSTEMS, INC. *Dept. N-10, Danvers, Mass. Tel.: SPring 4-1870.*

WESTERN DIVISION: *6214 West Manchester Avenue, Los Angeles, 45, California ORegon 8-0025.*

OTHER CRAIG PRODUCTS . . . . *transportable and mobile electronic systems, shelters, trailers, vans, mobile control towers, missile carriers, re-usable containers, antenna towers and masts.*

AVIATION CALENDAR

(*Continued from page 5*)

Oct. 9-11—National Fall Convention, Society for Experimental Stress Analysis, El Cortes Hotel, San Diego, Calif.

Oct. 10-11—National Noise Abatement Symposium, Sherman Hotel, Chicago, Ill.

Oct. 16—Constant Speed Drive Development, AIEE, Engineers Club, Philadelphia, Pa.

Oct. 16-18—Conference on Computers in Control, American Institute of Electrical Engineers, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

Oct. 16-18—1957 IRE Canadian Convention, Automotive Building, Exhibition Park, Toronto, Ont., Canada.

Oct. 17-18—13th Annual Convention, The Magnesium Association, Biltmore Hotel, New York.

Oct. 20-22—American Helicopter Society Fourth Annual Western Forum, Hotel Statler, St. Louis, Mo.

Oct. 21-22—Canadian Aeronautical Institute—Institute of the Aeronautical Sciences Meeting, Montreal, Canada.

Oct. 21-23—Conference on New Developments in the Field of Power, American Society of Mechanical Engineers, Americus Hotel, Allentown, Pa.

Oct. 21-25—45th National Safety Congress, Conrad Hilton Hotel, Chicago.

Oct. 22—Third World Conference for Aviation, month-long meeting on tariffs, cargo, etc., Sao Paule, Brazil.

Oct. 24-25—Fourteenth Annual Display, Aircraft Electrical Equipment, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles.

Oct. 24-25—Computer Applications Symposium, Morrison Hotel, Chicago; sponsored by Armour Research Foundation of Illinois Institute of Technology.

Oct. 28-29—Third Annual Meeting, Association of the U. S. Army, Sheraton-Park Hotel, Washington, D. C.

Oct. 28-29—First National Conference on Applied Meteorology, Hotel Statler, Hartford, Conn.

Oct. 28-30—Annual East Coast Conference on Aeronautical and Navigational Electronics, Fifth Regiment Armory, Baltimore, Md.

Oct. 28-31—Second Winter Meeting, American Nuclear Society, Henry Hudson Hotel, New York.

Oct. 28-31—National Industrial Packaging & Handling Exposition, Atlantic City Convention Hall, N. J.

Oct. 30—Aviation Electrical Equipment Display, U. S. Grant Hotel, San Diego.

Oct. 31-Nov. 1—Fourth Annual Meeting, Professional Group on Nuclear Science, Henry Hudson Hotel, New York.

Nov. 2-8—Second World Metallurgical Congress & 39th National Metal Exposition & Congress, Palmer House, Hotel Sherman and International Amphitheatre, Chicago.

Nov. 4-8—Fourth Institute on Electronics in Management (automatic data processing system), The American University, 1901 F St., Washington 6, D. C.

Nov. 5-7—Joint Military-Industry Guided Missile, Reliability Symposium (limited to those with Secret security clearance), Naval Air Missile Test Center, Pt. Mugu, Calif.

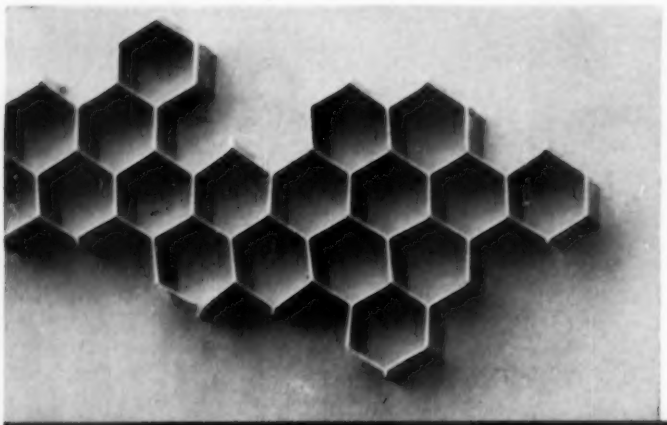
CYCLONE 9 powered SIKORSKY S-58s fly in world's largest ferrying operation

Offshore oil development moves at a rapid pace in the Gulf of Mexico, where Humble Oil & Refining Company operates the world's biggest helicopter ferrying operation. Last year, more than 85,000 passenger trips were made from Grande Isle, Louisiana just carrying employees to the fifteen Humble drilling rigs in the Gulf. Latest additions to Humble's fleet of helicopters are four giant Sikorsky S-58s, powered by specially adapted, advanced models of the Curtiss-Wright Cyclone 9 engine.

The trip from shore to rig used to take four or five hours in a lumbering workboat. Now it's a pleasant half-hour hop. And the same transformation — from time-consuming, drudgery surface travel to quick by-air connections — is the pattern wherever Cyclone 9-powered 'copters are put to work. In military service, in airport-to-city helicopter airlines, in rough-terrain rescue and supply work, in messenger and delivery service for industry, the modern helicopter has assumed its rightful stature and is steadily increasing in importance in today's transport picture.

WRIGHT AERONAUTICAL DIVISION
CURTISS-WRIGHT
CORPORATION • WOOD-RIDGE, N. J.

World's Finest Aircraft Engines



cell structure
for the
Snark missile

HEXCEL ALUMINUM HONEYCOMB

In designing the USAF Snark SM-62 missile, Northrop engineers specified Hexcel Aluminum Honeycomb for certain principal structural members. And for good reasons. Here are two of them.

Burr-free edge conditions are standard with all Hexcel Aluminum Honeycomb cores. Hexcel burr-free bonding surfaces not only ease the fabrication of sandwich structures, but they give them greater fatigue resistance, because of the total contact between the bonded surfaces.

Hexcel Aluminum expanded honeycomb cores are more than 99% aluminum—the percentage of adhesive is an efficient minimum. Thus, the amount of actual working, structural material is greater, which, in effect, increases the strength-to-weight ratio of structural sandwiches.

Research and engineering for better honeycomb core materials—of aluminum and of heat-resistant glass fabric—are continuous at Hexcel. Our research facilities and sales-engineering staff are at the aircraft industry's immediate service.

HEXCEL® PRODUCTS INC.
America's leading producer of honeycomb core materials
951-61st Street, Oakland, California

PLANTS: OAKLAND, BERKELEY, CALIF.; HAVRE DE GRACE, MD. • SALES OFFICES: NEW YORK CITY; INGLEWOOD, CALIF.; FORT WORTH, TEXAS

hold everything!

Ingenious invention backed by years of research have produced many time-proved proprietary items.
CABUCKLE
HI-SHEAR RIVETS
HI-TORQUE BOLTS
LONG-LOK FASTENERS
SCHWEPPE STUD
LOCKBOLTS
special fasteners for every purpose
There is a V-S Fastener of GUARANTEED STRENGTH to suit your exact need. No matter what the requirement . . . what the configuration . . . what the material . . . your best source for aircraft fasteners is VOI-SHAN
this space reserved
for new products created by Voi-Shan's inventive leadership.
The ultimate in facilities, skill, and experience is your assurance of consistent perfection in every type fastener.
HEX HEAD
FLUSH HEAD
INTERNAL WRENCHING
EXTERNAL WRENCHING
The most complete versatility in types and sizes of special fasteners plus mastery of a multitude of materials is yours at VOI-SHAN.
VOI-SHAN
FASTENERS

VOI-SHAN MANUFACTURING COMPANY • 8463 Higuera Street, Culver City, California
A division of PHEOLL MANUFACTURING COMPANY • Offices in principal cities of the United States and Canada

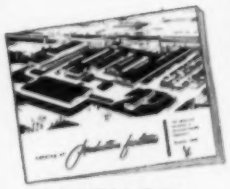
Amweld® Hits Your Cost Target

Forming and flash butt-welding of mill-rolled or extruded shapes has cut the cost of rings and other circular parts by as much as 50%! Savings to one manufacturer in reduced machining time and material was $220.63 per ring. Where expensive metals such as titanium and heat-resistant alloys are used, flash butt-welding offers the most economical and practical method of manufacturing circular products.

Similar economies are also realized on carbon steels and less expensive metals.

Write today. Let our engineering department demonstrate how Amweld can help you cut production costs on rings, bands and circular components.

THE AMERICAN WELDING & MANUFACTURING CO.
420 Dietz Road • Warren, Ohio



CATALOG OF PRODUCTION FACILITIES
Send for your copy now!

AMERICAN WELDING
The World's Leading Manufacturer of Welded Rings

from AMPHENOL

Research and Development

★

Two years in design and testing, AMPHENOL's proven Poke-Home contacts are ready! Six major new connector lines (in standard, rack & panel and miniature types) incorporating Poke-Home contacts are now being tooled. Watch for further announcements!

POKE-HOME CONTACTS

- ★ Wired outside the connector—"poked home" for assembly
- ★ Increased reliability
- ★ Individual wire maintenance
- ★ Ease of inspection
- ★ Adaptable to automation
- ★ Substantial reduction in wiring costs

AMPHENOL ELECTRONICS CORPORATION
chicago 50, illinois

Manufacturers of electronic equipment requiring accuracies hitherto impossible are pointing to Western Gear for the gears and units to drive and control their incredibly accurate equipment. Until now, mechanical accuracies have not been able to keep pace with the 100% reliability requirements of this equipment. But Western Gear research, design and manufacturing engineers have combined their talents to develop new methods and techniques for the production of intricate gear assemblies, gear control systems and even complete installations of a wide range of electronic equipment for ballistics and guidance. In this production, tolerances to 1/10,000 of an inch are commonplace, and we have equipment capable of working to 1 *millionth* of an inch, and repeating itself. If you have been told your guidance drive tolerance requirements are "impossible," call your Western Gear man. Write to Box 182, Lynwood, California for his name and address.

CALL THE WESTERN GEAR MAN!

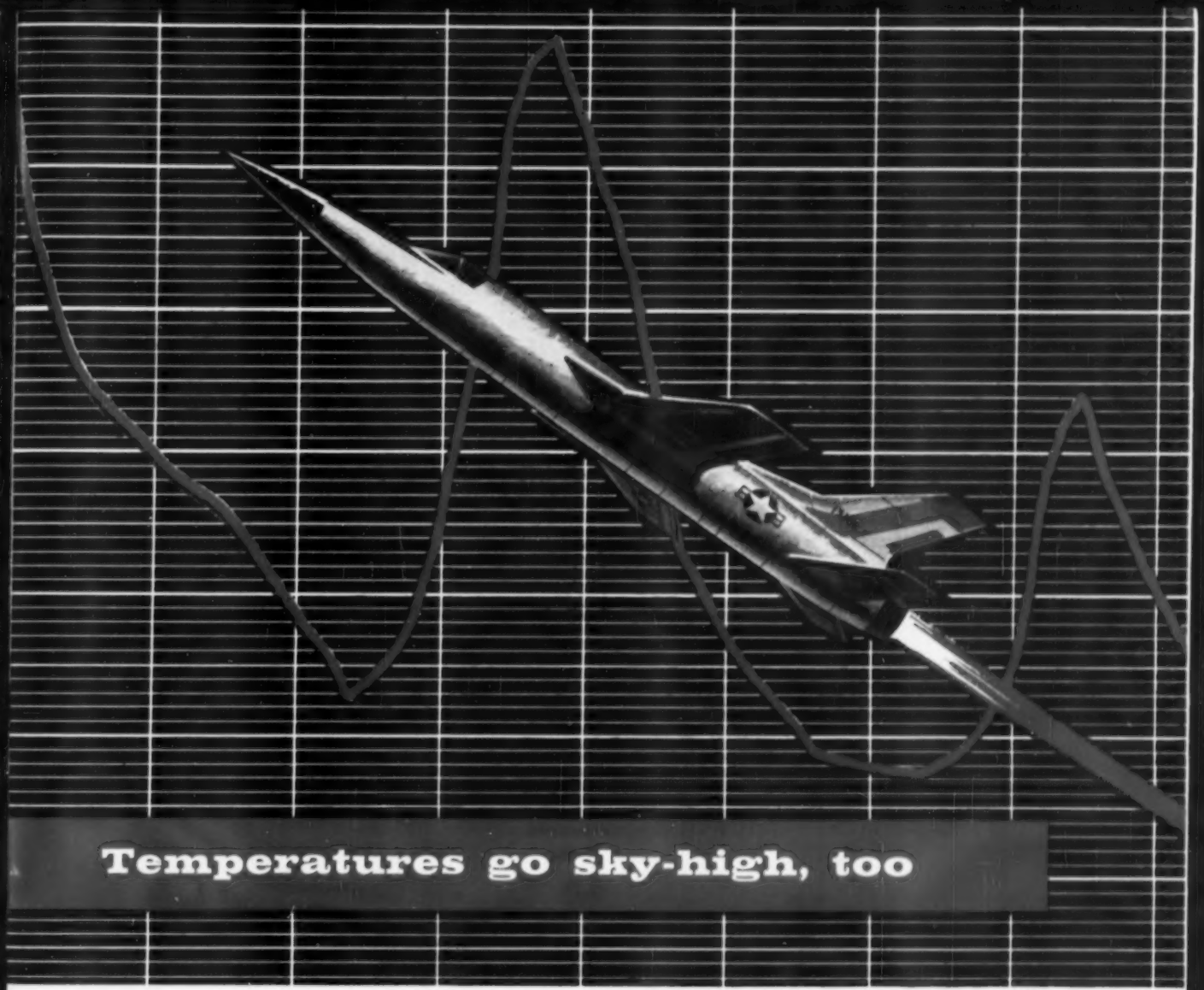
"The difference is reliability" • Since 1888

S763

WESTERN GEAR *Corporation*

ENGINEERS AND MANUFACTURERS

PLANTS AT LYNWOOD, PASADENA, BELMONT, SAN FRANCISCO (CALIF.)
SEATTLE AND HOUSTON — REPRESENTATIVES IN PRINCIPAL CITIES



Temperatures go sky-high, too

57-92

When precisely controlling the flow of fuel to the jet engine, a valve must operate smoothly in ambient temperatures see-sawing from sub-zero to torrid. Solving such problems in the age of jets makes Ex-Cell-O ideally suited for the solution of new problems. Ex-Cell-O builds high-temperature valves . . . along with blades, rotors, fuel nozzles, actuators, fuel controls, parts and assemblies.

EX-CELL-O FOR PRECISION XLO

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

Aircraft Division

MAN AND MISSILES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O.

III

This is the third of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

What Does Grain Size Mean In An Alloy Steel?

The grain size of alloy steels is understood to mean austenitic or inherent grain size. Austenitic grain size should be distinguished from ferritic grain size, which is the size of the grains in the as-rolled or as-forged condition with the exception of those steels that are austenitic at room temperature. When steel is heated through the critical range (approximately 1350 to 1600 deg F for most steels, depending on the composition), transformation to austenite takes place. The austenite grains are extremely small when first formed, but grow in size as the temperature above the critical range is increased, and, to a limited extent, as the time is increased. It is apparent, therefore, that both time and temperature must be constant in order to obtain reproducible results.

When temperatures are raised materially above the critical range, different steels show wide variations in grain size, depending on the chemical composition and the deoxidation practice used in making the heat. Heats are customarily deoxidized with aluminum, ferrosilicon, or a combination of deoxidizing elements. Steels using aluminum or certain other deoxidizers in carefully controlled amounts maintain a slow rate of grain growth at 1700 deg F, while heats finished with still other deoxidizers, usually ferrosilicon, develop relatively large austenitic grain size at temperatures somewhat below 1700 deg F.

The McQuaid-Ehn test is the one ordinarily used for determining grain size. Steel is rated with a set of eight ASTM charts that are compared one at a time with a specially prepared steel sample until one is found to match. Number 1 grain size, the coarsest, shows 1½ grains per sq in. of steel area examined at 100 diameters magnification. The finest chart is Number 8, which shows 96 or more grains per sq in. at the same magnification.

PROPERTIES AFFECTED BY GRAIN SIZE

Fine-grain steels (grain sizes 5, 6, 7, and 8) do not harden as deeply as coarse-grain steels, and they have less tendency to crack during heat-treatment. Fine-grain steels exhibit greater toughness and shock-resistance—properties that make them suitable for applications involving moving loads and high impact. Practically all alloy steels are produced with fine-grain structures.

Coarse-grain steels exhibit definite machining superiority. For this reason a few parts which are intricately machined are made to coarse-grain practice.

The correct specification and determination of grain structure in steel is a subject that has been given long study by Bethlehem metallurgists. If you would like suggestions on this or any other problem concerning alloy steels, these men will be glad to give you all possible help.

In addition to the entire range of AISI alloy steels, Bethlehem produces special-analysis steels and the full range of carbon grades.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Answers to the Toughest Problems in Jet Aircraft Cooling...

LIGHTWEIGHT...THINWALL

STEWART-WARNER HEAT EXCHANGERS

Stewart-Warner's unexcelled experience can be used to meet your heat transfer needs!

Ram and blower heat exchangers—designed for Stratos refrigeration system used on Boeing B-52

Air-to-air Model 961-A—designed for the Hamilton Standard refrigeration system used on Chance-Vought F8U-1 "Crusader"

Oil-to-fuel Model 983-A, stainless steel tube bundle—designed for Lockheed C-130 "Hercules"

Air-to-air Model 994-A—designed for North American's F-100 "Super Sabre"

The South Wind Division of Stewart-Warner pioneered the development of heat exchange equipment for heating modern aircraft. Now South Wind is the leading producer of heat exchangers for *cooling*. Lightweight thinwall units in both stainless steel and aluminum—either air-to-air, air-to-liquid, or air-to-evaporating-liquid—are being designed and fabricated for a wide range of new and important uses. If *you* have a heat transfer problem, South Wind engineers can help you solve it. No obligation. Write to South Wind Division, Stewart-Warner Corporation, Indianapolis 7, Indiana.

STEWART SW WARNER

South Wind

Division of
STEWART-WARNER CORPORATION

ELECTRO-SNAP . . . ELECTRICAL CONTROLS

control problems?

ELECTRO-SNAP Engineering has solved many design and

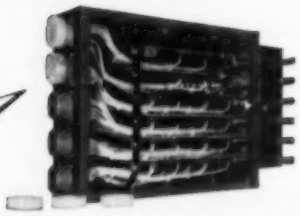
HERE'S HELP
we have given to others . . .

we know we can help you!

ELECTRO SNAP

We've been solving complex aircraft problems for years with precision-engineered assemblies like those shown here. Many of these we now make on a production basis were developed as a special answer to a specific problem.

The design and precision manufacture of reliable switches and controls is *our only* business. If you have a control problem, send it to us; our engineers will work with you closely in designing an answer—and producing it *in any quantity* . . . economically.



emergency fire control
this plunger-actuated, multipole assembly is installed at the flight engineer's console on the Douglas Globemaster. It feathers props, closes cowl and oil cooler doors, releases extinguishing fluid to one or more of six compartments, stops fuel and electrical service to fire area.

SEND US YOUR CONTROL PROBLEMS
and write for catalog details on our standard switches.

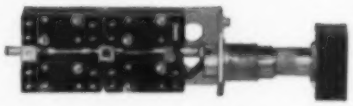
FOR AIRCRAFT AND MISSILES

YOU GET
- safety
- reliability
- precision

precision control
of aircraft landing gear is assured by this complete nose gear harness assembly which includes Electro-Snap hermetics.

control problems with precision accuracy . . .

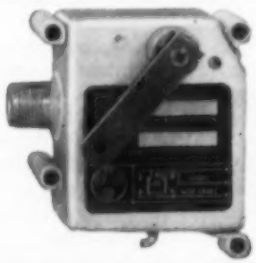
powering and de-powering
projectiles is dependably accomplished with this compact, hermetically-sealed assembly. Automatically actuated, it can be manually overriden. Design utilizes E-S rotary hermetic seal.



fire control switch
assures proper sequence during emergency fire conditions. Eliminates pilot error by controlling all functions when single handle is pulled.

rotary release switch
accurately controls release of fuel tanks and other objects from aircraft. Positive detent action assures finger-tip control and dependable performance.

rocket safety switch
assures tandem rockets will fire in proper sequence. Also indicates when rocket has been fired.

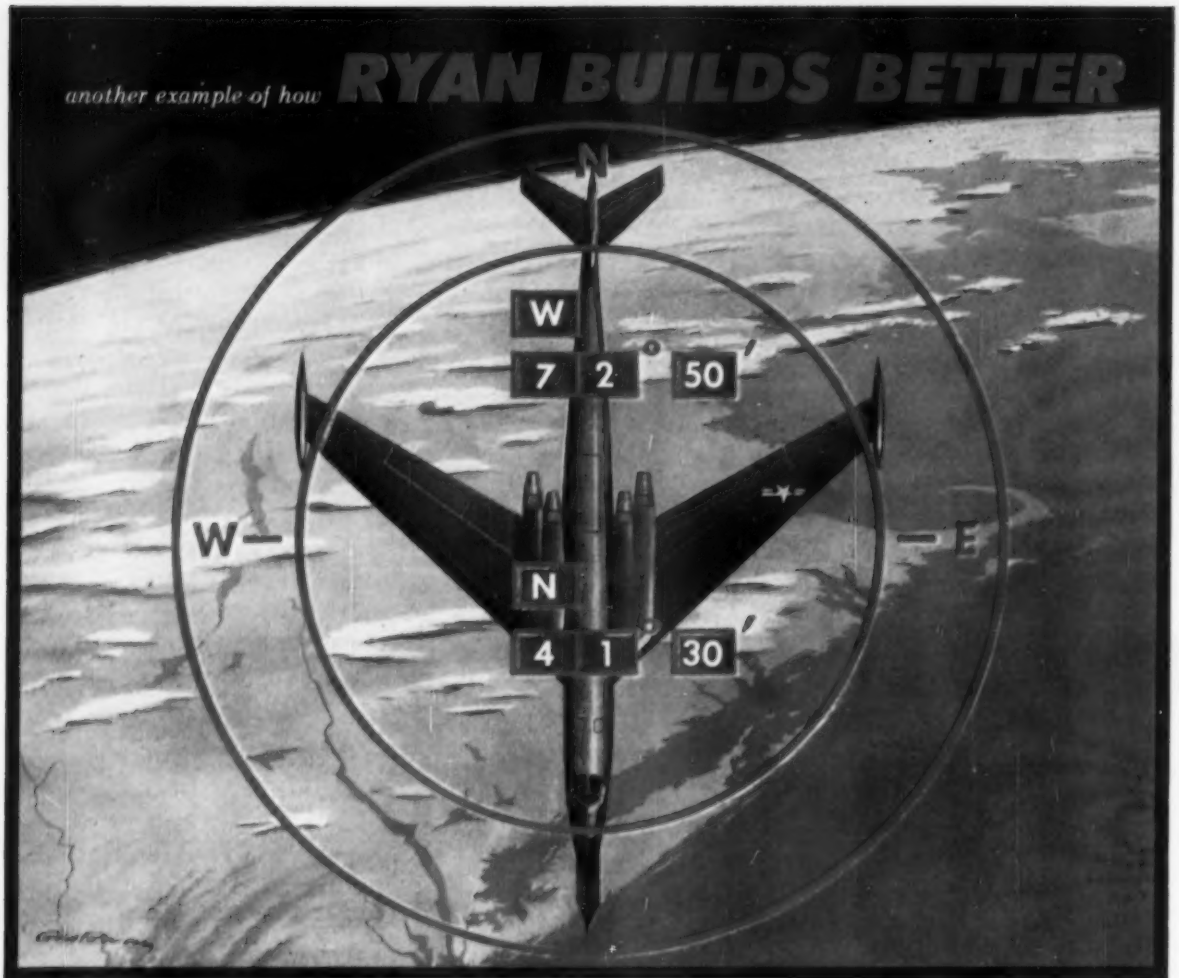


accurate control
of landing gear position is accomplished by this precision rotary hermetically sealed switch. Actuation occurs on either side of center within extremely close limits.

ELECTRO-SNAP
SWITCH & MFG. CO.
4248 W. Lake Street, Chicago 24, Illinois

SAFETY THROUGH CONTROLS — OUR ONLY BUSINESS

another example of how **RYAN BUILDS BETTER**



NOW! AUTOMATIC NAVIGATION FOR GLOBAL JET FLIGHT

An advanced system of aerial navigation, with the speed and precision demanded by high speed jet flight, has been developed by Ryan under sponsorship of the Navy's Bureau of Aeronautics. Using continuous-wave radar, in which Ryan is a recognized leader, the Ryan AN/APN-67 navigator will enable fast-flying military planes and future commercial jetliners to travel to any point on the earth's surface with new accuracy and speed.

Instantaneous in operation, the Ryan navigator gives the pilot his position (latitude and longitude), *ground* speed, *ground* mileage, drift angle and *ground* track in continuous, readable form. No computations are necessary. The equipment is compact and self-contained. No ground facilities are employed—no wind information or aerological data are needed.

This significant contribution to jet navigation is typical of the work which Ryan and the military services are accomplishing in other fields of electronics research such as supersonic missile guidance for the Air Force and helicopter hovering devices for the Navy.

Electronics engineers will find a challenging future with outstanding opportunities at Ryan

BUILDING AVIATION PROGRESS SINCE 1922

Aircraft • Power Plants • Avionics

Ryan Aeronautical Company, San Diego, Calif.

Ryan

September 30, 1957

AVIATION WEEK

Vol. 67, No. 13

Editorial Offices

New York 36—330 W. 42nd St., Phone: LOngacre—4-3000 (Nights LO 4-3035)
Washington 4, D. C.—National Press Bldg., Phones: NAtional 8-3414, REpublic 7-6630
Los Angeles 17—1125 West Sixth St., Phone: MAdison 6-9351
Dallas 1—1712 Commerce St., Phone: RIverside 7-5117

European Office—1 rue du Temple, Geneva, Switzerland

PUBLISHER.....Robert W. Martin, Jr.
EDITOR.....Robert B. Hotz

MANAGING EDITOR.....Alpheus W. Jessup
ASST. MANAGING EDITOR (TECHNICAL) David A. Anderton
WASHINGTON.....Cecil Brownlow
NEW YORK.....William Gregory, Robert I. Stanfield, Harry Raven
LOS ANGELES.Irving Stone, Richard Sweeney
DALLAS.....Craig Lewis
ENGINEERING.....Robert H. Cushman, Russell Hawkes, J. S. Butz, Jr.
AVIONICS...Philip J. Klass, James A. Fusca
CONGRESS.....Katherine Johnsen
MILITARY.....Claude G. Witze, Evert Clark
TRANSPORT.....Glenn Garrison, L. L. Doty, Ford Eastman
EQUIPMENT.....G. L. Christian
BUSINESS FLYING.....Erwin J. Bulban
ART EDITOR.....Lawrence J. Herb
ASST. ART EDITOR.....Robert G. Young
EDITORIAL PRODUCTION...Jerome E. Kelley
EDITORIAL ASSISTANTS..Elizabeth M. Hein, Marjorie Nail, Jerome Bailey, Edith Walford
LIBRARIAN.....Jeanne Rabstejnek

FOREIGN NEWS SERVICE

EDITOR.....John Wilhelm
LONDON.....William J. Coughlin
PARIS.....Robert E. Farrell
BONN.....Morrie Helitzer
MEXICO CITY.....John H. Kearney
RIO DE JANEIRO.....Peter Weaver
TOKYO.....Dan Kurzman

DOMESTIC NEWS BUREAUS

ATLANTA 3.....1301 Rhodes-Haverty Bldg.
CHICAGO 11.....520 No. Michigan Ave.
CLEVELAND 15.....1510 Hanna Bldg.
DETROIT 26.....856 Penobscot Bldg.
HOUSTON 25.....1303 Prudential Bldg.

SALES

ADVERTISING SALES MANAGER E. P. Blanchard, Jr.
PROMOTION AND RESEARCH MANAGER W. H. Jack
ATLANTA.....R. H. Powell
BOSTON.....A. C. Boughton
CHICAGO and ST. LOUIS.....J. S. Costello, F. E. Bauman
CLEVELAND.....H. P. Johnson
DALLAS.....Gordon Jones, E. E. Schirmer
DENVER.....John G. Patten
DETROIT.....C. A. Ransdell
LOS ANGELES.....C. F. McReynolds, D. T. Brennan, D. A. McMillan
NEW YORK.....M. J. Storz, R. G. Hathaway, R. R. Butera
PHILADELPHIA...W. S. Hessey, J. D. Willis
SAN FRANCISCO.....William Woolston

BUSINESS

BUSINESS MANAGER.....J. G. Johnson
CIRCULATION MANAGER.....T. J. Lucey
PRODUCTION MANAGER.....W. V. Cockren

RESEARCH AND MARKETING

Mary Whitney Fenton, Judith P. Wheeler

Fighters Compete for NATO Approval 26
► Lack of Power in all five contenders leads observers to believe prize will be limited-quantity pre-production order.

Britannia Delays Hit BOAC, Northeast 37
► U. S. airline, which won't get aircraft for Florida season peak, sets conditions for retention of order.

P. 1B Combines Maneuverability, Speed 50
► Britain's first true supersonic intercepter shown at Farnborough compares favorably with U. S. fighters.

MISSILE ENGINEERING

Thor Bolsters USAF Hopes 31
Atlas Firing 30
Missile Delegates 'Watch, Wait' 30
British Missile Names 34

AERONAUTICAL ENGINEERING

P. 1B Has Maneuverability, Speed 50
Soviet's Claim Tu-104 Record 33
Bell Tests H-40 Drive 61
Precise Hydraulic System 62
Rotodyne Rotor Details 64
Short SC. 1 VTOL 69

AVIONICS

AMB's First Major Program 29
Materials for 500C Components 70
Changes in Avionics Industry 79
Filter Center 79

FINANCIAL

Navy Contracts 102
USAF Contracts 102
Certificates of Necessity 107

BUSINESS FLYING

Grumman Prices Gulfstream 29
Prototype May Stimulate Orders 108
Lightplane Production Considered 113
Sprayers Grossed $90 Million 114
Private Lines 114

AIR TRANSPORT

Australian Line Orders Electras 33
ATA Challenges Airspace Plan 34
Lines May Retain Sales Profit 38
Thrust Improves Russia's Tu-110 40
U. S. Lines Supported by Varig 43
Airlines Promote Jet Travel 44
Shortlines 47
Airline Observer 47

EQUIPMENT

Infrared Simulates Heating 81
New Helmet Visor 87
Low Cost Reflector 90
Off the Line 93
What's New 94
British Developing Copter Simulator 103

MANAGEMENT

Defense Spending Outlook 30
Hurley Replies to Hebert Charge 33
Navy Balks at Contract Training 34
Who's Where 23
Industry Observer 23
Washington Roundup 25
News Digest 34

Calendar 5
Letters 130

EDITORIAL

Perspective on Missiles 21

COVER: Three of four Allison flying test beds passing over Indiana are, top to bottom: Allison Turbo-Liner with Model 501 engines and Aeroproducts 606 four-bladed propellers; Air Force YC-131C with YT56 engines and Aeroproducts three-bladed propellers; and Lockheed C-130 Hercules with T56-A-1 prop-jet engines and Aeroproducts three-bladed propellers. Allison has logged 80,000 flight hr. on T56; 1,000 on 501. Fourth test bed is B-17, absent for change to nose-mounted T56 engine and Aeroproducts three-bladed propeller.

Picture Credits:
26, 27, 28, 58, 64, 83—Russell Melcher; 31—Wide World.

69,665 copies of this issue printed
AVIATION WEEK • September 30, 1957 • Vol. 67, No. 13
Member of ABP and ABC

Uniformity in handling and service performance

Aircraft Cable ★ Terminals ★ Assemblies

by MACWHYTE

Uniformity in handling – uniformity in service are attained through rigid quality control and precision manufacturing. That's your assurance when you use Macwhyte "Hi-Fatigue" Aircraft Control Cable, Terminals, and Assemblies.

There's a complete line of sizes and types of Macwhyte Aircraft Control Cable in Galvanized, Tinned, and Stainless Steel. Properly PREformed, "Hi-Fatigue" cable lies dead with no tendency to unlay, twist, or curl. Assemblies can be made to closer tolerances, because there is minimum uniform stretch in any length of cable.

Macwhyte "Safe-Lock" Stainless Steel Terminals for swaging are manufactured to exceed the requirements of Military Specifications.

Macwhyte Aircraft Cable is available in reel lots or cut to length. Terminals are sold loose or attached to cable. Assemblies are made to order.

Ask for Macwhyte Aircraft Catalog A-3.

MACWHYTE COMPANY
2906 Fourteenth Avenue, Kenosha, Wisconsin

Manufacturers of "Hi-Fatigue" Aircraft Cable—"Safe Lodk" Cable Terminals—Cable Assemblies—Tie Rods—Braided Wire Rope Slings—Bright, Galvanized, Stainless Steel, and Monel Metal and Plastic Coated Wire Rope.

Mill Depots: **New York 4,** 35 Water St. • **Pittsburgh 19,** 704 Second Ave. • **Detroit 3,** 75 Oakman Blvd. • **Chicago 6,** 228 S. Desplaines St. • **St. Paul 14,** 2356 Hampden Ave. • **Ft. Worth 1,** P. O. Box 605 **Portland 9,** 1603 N.W. 14th Ave. • **Seattle 4,** 87 Holgate St. • **San Francisco 7,** 188 King St. • **Los Angeles 21,** 2035 Sacramento.

Perspective on Missiles

Guided missiles of all varieties will continue to enter the aerial weapon systems arsenal in increasing numbers during the next decade. Right now however there is a great need for some realistic perspective on just how and when missiles will fit into the defense picture of the next decade.

There is considerable evidence on the public record indicating that the missile has been vastly oversold by its non-technical proponents particularly on the vital factors of cost and reliability. There has been a tendency on the part of military medicine doctors to sell the public and Congress a mixture of "missile-economy" snake oil that is supposed to cure all budgetary and defense ills in a twinkling of the eye.

The recent British defense revisions are perhaps the worst example of how a nation can seriously weaken its defenses in order to pursue the missile chimera as an easy and economical way out of what are really knotty defense problems.

Expensive Integration

The idea that missiles will quickly replace all manned aircraft in the defense picture is no longer given any serious consideration, if indeed it ever was, by top level defense planners. Based on the hard facts of practical missile development experience we know that integrating missiles into the defense arsenal is going to be a longer and more expensive process than was first anticipated.

Missiles will assume their role in defense as an evolutionary not a revolutionary process. Nor will they ever completely eliminate the necessity for manned aerial vehicles. This is primarily because of the fact that scientists have not yet nor are they likely to in the foreseeable future invent an avionic "black box" that can take over the thinking function of a man or even remote that function out of certain types of aerial vehicle. Military situations will always (on our side at least, we hope) require human thought as an essential ingredient for success. Thus the missile which can relieve man of many mechanical functions will supplement not replace the manned vehicles that transport their own thinking mechanisms in the form of pilots and crewmen.

'Ultimate' Weapon Myth

There has been a good deal of nonsense in the public prints plumping the thesis that missiles particularly in their ballistic form are an "ultimate" weapon against which there is no possible defense. This is pure poppycock. There never has been nor is there likely to be an "ultimate" weapon against which there can be no defense. For every new weapon eventually there is developed a counterweapon that checks or limits its effectiveness. There are already several promising approaches to defense against a long range ballistic missile and lack of progress in this field is due mainly to lack of imagination in the Pentagon in pushing this defensive phase as hard as it is now pushing development of the offensive ballistic missile. Similarly there are scientific avenues that may produce techniques of neutralizing atomic and hydrogen bombs and warheads in the air before they can be exploded on a target.

Missiles must also be viewed in a realistic technical perspective. Far from being the "ultimate" development in aerial weapons technology they are doomed by the galloping technology of our times to be just an interval (albeit a substantial interval) in the time scale of weapons progress. As Dr. Theodore von Karman pointed out to a recent American Rocket Society meeting, the ballistic trajectory is basically an inefficient method of delivering a payload either for war or peace and the ceaseless search of science will inevitably produce more efficient methods of doing this job. Already the rocket-powered hypersonic glide bomber is looming on the technical horizon as a development that may make the current Atlas and Titan type intercontinental ballistic missiles appear in retrospect as technically simple as Chinese firecrackers.

Missiles will also have to fight their way into the operational performance category on a basis of mission performance superiority over their manned competitors. For example the Army's Nike Ajax ground to air missile can't even get in the same ball park with the Convair F-102 and Northrop F-89 armed with Douglas MB-1 atomic-tipped air to air missiles when it comes to the job of knocking down jet bombers before they can unload atomic weapons on a target.

Nike Waste

The billions the Army has poured into land, concrete and missiles for its Nike Ajax system, designed at the very best to stop piston-engined bombers over short ranges, is a classic example of military waste through stupid planning.

Similarly it will be a moot point as to whether the Boeing Bomarc ground to air missile will do a better air defense job over the ranges required than the Mach 2 Convair F-106 with its atomic missile punch. In the short range bombardment field there should be a similar efficiency yardstick applied to mission performance of manned and unmanned vehicles rather than a blind acceptance of a guided missile because it is wrapped in technical glamor.

As the hard facts of finance and reliability are faced in missile programs, we predict that both Britain and the United States will realize that the missile time scale for practical operational efficiency is stretching out. Consequently, at least another complete generation of manned defensive and offensive vehicles utilizing less sophisticated types of missiles as a supplement to their combat capabilities will be necessary to maintain the continuity of a strong aerial defense system against any potential disturbers of the peace.

—Robert Hotz

DEPENDABLE
FORGINGS for...
the Jet-Missile Age
1
2
3
4
5
6
7
8
KEY TO FORGINGS ILLUSTRATED
1. Jet Engine Pad — Titanium — 11 lbs. —17 inches.
2. Jet Engine Vane — Titanium — 27 lbs. — 15 inches.
3. Aircraft Support — Aluminum — 20 lbs. — 49 inches.
4. Aircraft Fitting — Aluminum — 282 lbs. — 86 inches.
5. Aircraft Landing Gear — Aluminum 284 lbs. — 47 inches.
6. Missile Ring Splice — Aluminum — 54 lbs. — 20 inches.
7. Aircraft Spar Frame — Aluminum — 434 lbs. — 142 inches.
8. Missile Fin — Aluminum — 8 lbs. — 30 inches.
Faster and faster, higher and higher — greater stresses, increased temperatures — all leading to continually increasing dependence on forgings — and in the forging field there is no substitute for Wyman-Gordon quality, experience and know-how.
U.S. AIR FORCE

WYMAN-GORDON COMPANY

Established 1883

FORGINGS OF ALUMINUM • MAGNESIUM • STEEL • TITANIUM

WORCESTER 1, MASSACHUSETTS

HARVEY, ILLINOIS • DETROIT, MICHIGAN

WHO'S WHERE

In the Front Office

I. W. Wilson, board chairman, and **Frank L. Magee,** president, Aluminum Company of America, Pittsburgh, Pa. Also: **Harold C. Erskine,** a vice president.

Edwin T. Asplundh, board chairman, Pittsburgh Plate Glass Co., Pittsburgh, Pa. Mr. Asplundh succeeds **Harry B. Higgins,** retiring.

Charles S. Rockwell, president and general manager, Ford Instrument Company, division of Sperry Rand Corp., Long Island City, N. Y. Mr. Rockwell succeeds **Raymond F. Jahn,** retiring.

Dr. I. A. Oehler, executive vice president and a director, The American Welding and Manufacturing Co., Warren Ohio.

G. Marion Sadler, vice president-customer service, American Airlines, Inc.

Laurance H. Cooper, vice president-administration, Air Logistics Corp., Pasadena.

Dale V. Cropsey, vice president-industrial divisions, Elgin National Watch Co., Elgin, Ill.

Elbert Cheyno, vice president-maintenance and engineering, Alaska Airlines, Inc. Mr. Cheyno succeeds **Thomas A. Campobasso** who has joined the management of Collins Radio Corp., Dallas, Tex.

Stanley J. Zak, vice president, Mandrel Industries, Inc., Houston, Tex. Mr. Zak is general manager of Mandrel's Greenleaf Manufacturing Co.

William C. Denison, a vice president and an Operations Policy Committee member, American Brake Shoe Co., New York, N. Y.

Glenn G. Whitaker has resigned as vice president-field engineering of Wm. R. Whittaker Co., Ltd., Los Angeles, Calif.

Maxwell D. Millard, assistant vice president-sales, American Steel & Wire Division, United States Steel Corp., Cleveland, Ohio.

Lt. Col. George R. Steinkamp has succeeded **Dr. Hubertus Strughold** as head of the Department of Space Medicine, Air Force School of Aviation Medicine, Randolph AFB, Tex. Dr. Strughold, founder of the Department, is now Advisor for Research to the Commandant of the School.

Dr. Antonio Ferri has been named head of the Aeronautical Engineering Department, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Philip A. Eby, administrative assistant to the president, Riddle Airlines, Inc.

Changes

Dr. Klaus C. Karde, director-engineering, research and development, Michle-Dexter Supercharger Division, Dexter Folder Co., Racine, Wisc.

John J. Flaherty, assistant to the general manager, Atomics International, division of North American Aviation, Inc., Canoga Park, Calif.

Daniel A. Peters, Jr., general manager, Babb Co., Inc., Linden, N. J.

Dr. Donald K. Coles, head-solid state laboratory, Farnsworth Electronics Co., Fort Wayne, Ind.

(Continued on page 117)

INDUSTRY OBSERVER

► General Electric Co. analysis of its many defense electronics programs, made to determine what percentage of its equipment or techniques have applications in both the missile and piloted aircraft field, reveals that about 80% are applicable to both. Approximately 25% of GE's avionic development effort is currently earmarked for specific missile programs.

► **De Havilland Propellers Ltd. has designated its intermediate range ballistic missile (AW Aug. 26, p. 23) Project Six. Test stand visible at Hatfield is for cold flow tests of systems and simulates actual missile parameters.**

► Defense Department is reviewing USAF's decision to purchase Kaman's HOK-3 local air base rescue helicopter. Some Defense officials feel the Air Force could save money by purchasing Bell's H-40 for which Army already has borne most of the development costs. Both helicopters are turbine-powered, have approximately same capacity. Bell and Army have agreed to divide the H-40 production output with USAF, with the Air Force bearing none of the cost for early production models where the cost is higher.

► **Canadair production of the Sparrow II air-to-air missile under license from Douglas Aircraft Co. is being withheld pending a decision by Canadian Westinghouse on the type guidance the missile should use. Present plans call for production of approximately 300 Sparrow IIs.**

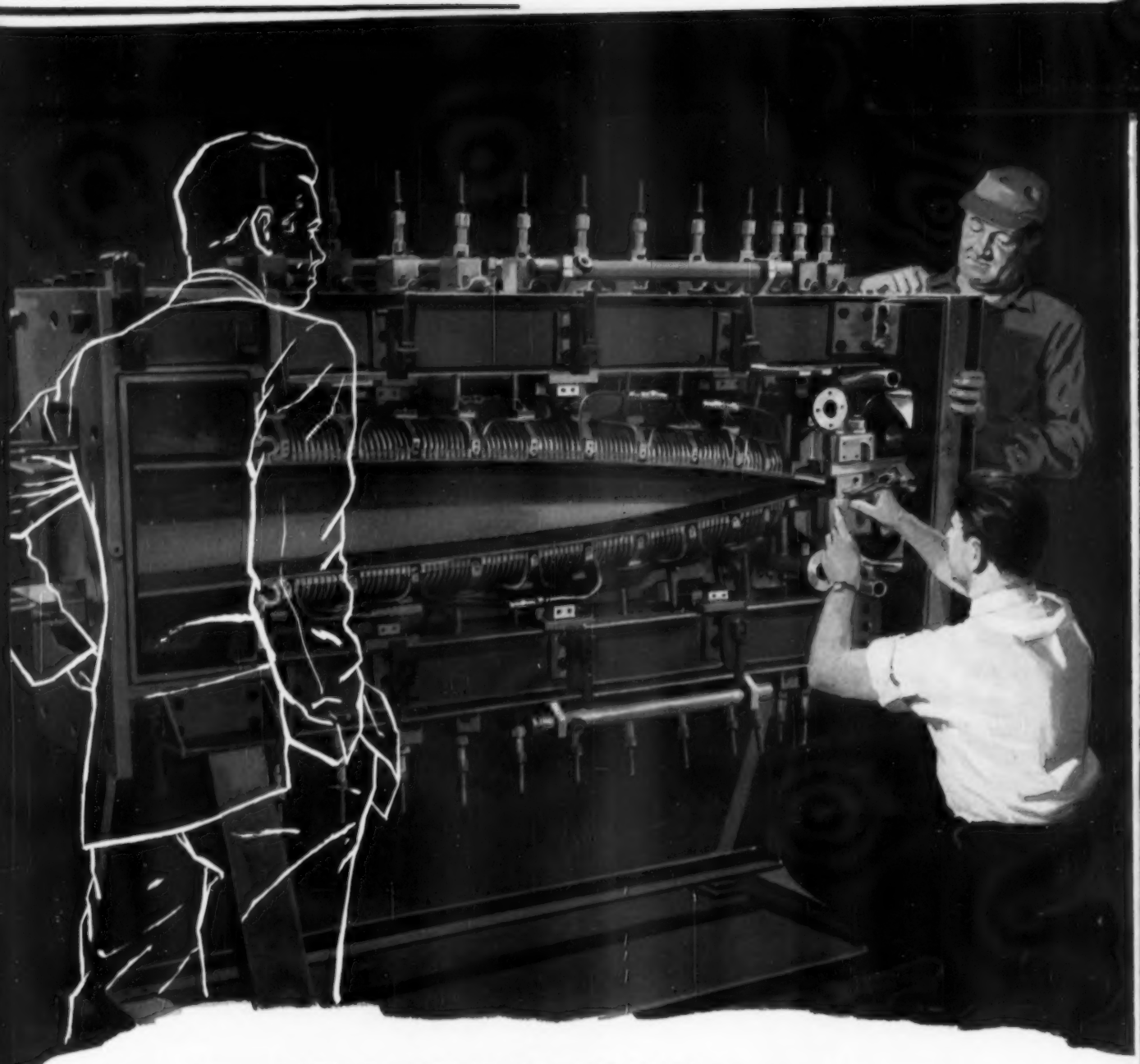
► ICBM and IRBM tests being conducted by Naval Ordnance Laboratory include use of newly developed two-stage hypervelocity gun capable of firing projectiles at 18,000 ft. per sec. When first chamber of gun is fired, pressure rises to 8,000 psi. Thousandth of a second later, rear combustion chamber fires, pressure there rises to 48,000 psi. and ruptures the diaphragm between front and rear chambers. Crushing force first bounces off gas in pressurized front chamber, then rebounds toward the rear, raising pressure to 60,000 psi. and temperature to 10,000F. Heat and pressure combination bursts through front diaphragm and hurls the projectile from the barrel.

► **Defense Department is taking a close look at Army's requirement for a three-ton helicopter, calling in Navy and USAF for consultation on the specifications. There is a strong possibility that the three services may reach an agreement whereby one design will be suitable for all their requirements. If negotiations are successful, it will mark the first time an aircraft has been specifically designed and built for the triple military market. Army will use the helicopter for mobility in the field, Navy for Marine assault missions and USAF for transport, probably on logistics missions serving missile launching sites.**

► Fuel dipping fix on Hawker Hunters powered by Rolls-Royce Avon turbojets has cured engine blowout troubles which occurred when guns were fired at altitude. Fix is a switch incorporated into gunfire control that momentarily reduces the fuel flow a split second before firing, drops engine performance far enough below the surge line so that there is no chance of a blowout or stall. Same fix is going into the high-altitude version of the Bristol Orpheus slated for the interceptor version of the Folland Gnat.

► **Napier Flight Development Division at Luton is reworking two Gloster Javelins for new powerplants. One will carry de Havilland Gyron Juniors with afterburners; the other Rolls-Royce Avons, possibly the R. A. 24R series. Present Javelins are equipped with two Armstrong-Siddeley turbojet engines.**

► Rand Corp. is establishing an independent non-profit corporation to undertake the training of air defense center personnel for the Air Defense Command. Rand, utilizing an application of computers, has simulated on air defense radar equipment possible enemy bombing patterns on the U. S. and has quickly trained average I. Q. USAF airmen how to initiate and pursue effective defense missions.



HOW THE SILICONES MAN HELPED...

CHANGE THE TUNE OF A MACH 5 WHISTLE

Ram a wind thirty-six hundred miles an hour down a wind tunnel 20 inches square. Problems in testing models of supersonic rockets and missiles in such a tunnel gave new dimensions to operational techniques.

Developed by engineers of the Jet Propulsion Laboratory at California Institute of Technology, this advanced wind tunnel presented many unique problems. In order to control the air going into the test section, movable plates were used to vary the area of the opening. The plates, moving against one another, had to be sealed. The abrasion created by this movement destroyed ordinary sealing materials. That is, until UNION CARBIDE Silicone Rubber was used. Fabricated by Reeves Rubber, Inc., of San Clemente, California, in solid strips . . . in hollow tubing that is pressurized for an extra tight fit . . . this silicone rubber performed exceptional service under almost "impossible" conditions. In fact, tests indicate that maintenance will only be required once every two or three years!

This is another example of how the UNION CARBIDE Silicones Man has helped solve an "impossible" problem. A booklet—"Look to UNION CARBIDE for Silicones" describes silicone rubber and many other silicone products. Write Dept. AW95 today. Silicones Division, Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.

UNION CARBIDE TRADE-MARK SILICONES

The term "Union Carbide" is a registered trade-mark of UCC.
In Canada: Bakelite Company, Division of
Union Carbide Canada Limited, Belleville, Ontario.

Washington Roundup

Buying Program Firms

Watch for final release of USAF's final Fiscal 1958 buying program within the next couple of weeks. This will soon be followed by the release of some money due contractors to launch production.

The Defense Department confirms that shopping lists have been delayed for the most part, with only enough released to keep essential wheels rolling. Normally, these obligational authorities are released at the beginning of the fiscal year, but certain knowledge that ceilings will be in force for the future has forced the department to undertake slow review of the contracts to be signed in next few months.

Defense says any trouble encountered now or in the next quarter, beginning tomorrow, that involves current bills is a problem of the Air Force, which is trying to pay for hardware ordered a few years ago and underpriced at that time. This circumstance has forced the military services to deal out money for current expenditures with extreme care.

"If a contractor is forced to borrow cash in order to keep operating," AVIATION WEEK is told, "it is because there is more program under way in his plant than USAF can pay for and stay within this year's ceiling. He is going at 60 mph., a speed that was picked out a long time ago, and slowing to 40 is going to be tough on the brakes."

No-Show Penalty: Tipton Pays

First passenger in the U.S. to be penalized by the no-show penalty plan shelled out his $3 fine without audible protest after missing a flight on the West Coast early on the morning of Sept. 15, effective date of the plan. The offender: Stuart G. Tipton, president of the Air Transport Assn., which sponsored the plan.

National Strike

National Airlines estimated that 5,000 passengers a day were being turned over to other airlines in the 36 cities along its system because of a labor dispute that brought the airline's operations to a halt last week. National suspended service when members of the Air Line Agents Assn. called what the airline management termed an "illegal wildcat walkout." The union blamed the trouble on an "illegal lockout" of 16 members in New York. The matter was before a three-man mediation board late last week.

R & D Relief

Alarm over USAF research and development cuts, particularly in the Office of Scientific Research (AW Sept. 16, p. 27; Sept. 23, p. 26) has brought quick relief. OSR project monitors have now been told to tread water, not to carry out immediate cancellations as formally planned because the budget still stands at $16 million plus $3 million for payments on finished work. OSR now feels it can carry on and will feel the pinch mainly in its inability to undertake new contracts.

The action followed a wave of heated protests from universities, who were caught short on the eve of a new college year. Their cries were bolstered by the Defense Science Board, which spent its first meeting with Dr. Paul D. Foote, new Assistant Secretary of Defense for Research and Engineering, drafting a statement cautioning against R & D cuts. Subject was not on agenda.

Defense Secretary Charles E. Wilson says he does not know of any programmed cutback in research and development. The total to be spent, he added, will remain about the same, so that new projects will be possible only if some of the old ones are cut off "and some of this research and development ought to be finished some day. . . . Otherwise, all you are doing is underwriting a subsidy for some university. . . ."

Long Look

Radars capable of detecting intercontinental ballistic missiles out to ranges of 3,000 miles are "planned for operational employment in the near future," according to Gen. Thomas D. White, USAF chief of staff. White does not indicate whether new long-range radar is the Omnirange Digital Radar (ORDIR) recently disclosed by Columbia University (AW Aug. 19, p. 28). Similar developments reportedly are under way at Bell Telephone Laboratories, General Electric, Melpar, Radio Corporation of America, Sperry Rand, Westinghouse Electric and Lincoln Laboratory.

AMB Organizes

New three-man Airways Modernization Board held its first meeting last week following appointment of Defense and Commerce Department representatives—Malcolm A. MacIntyre, USAF Under Secretary, and Louis Rothschild, Assistant Secretary of Commerce for Transportation. Third member is AMB chairman, Elwood Quesada, President's special assistant for aviation facilities planning.

Helicopter Goes North

What became of the helicopter?

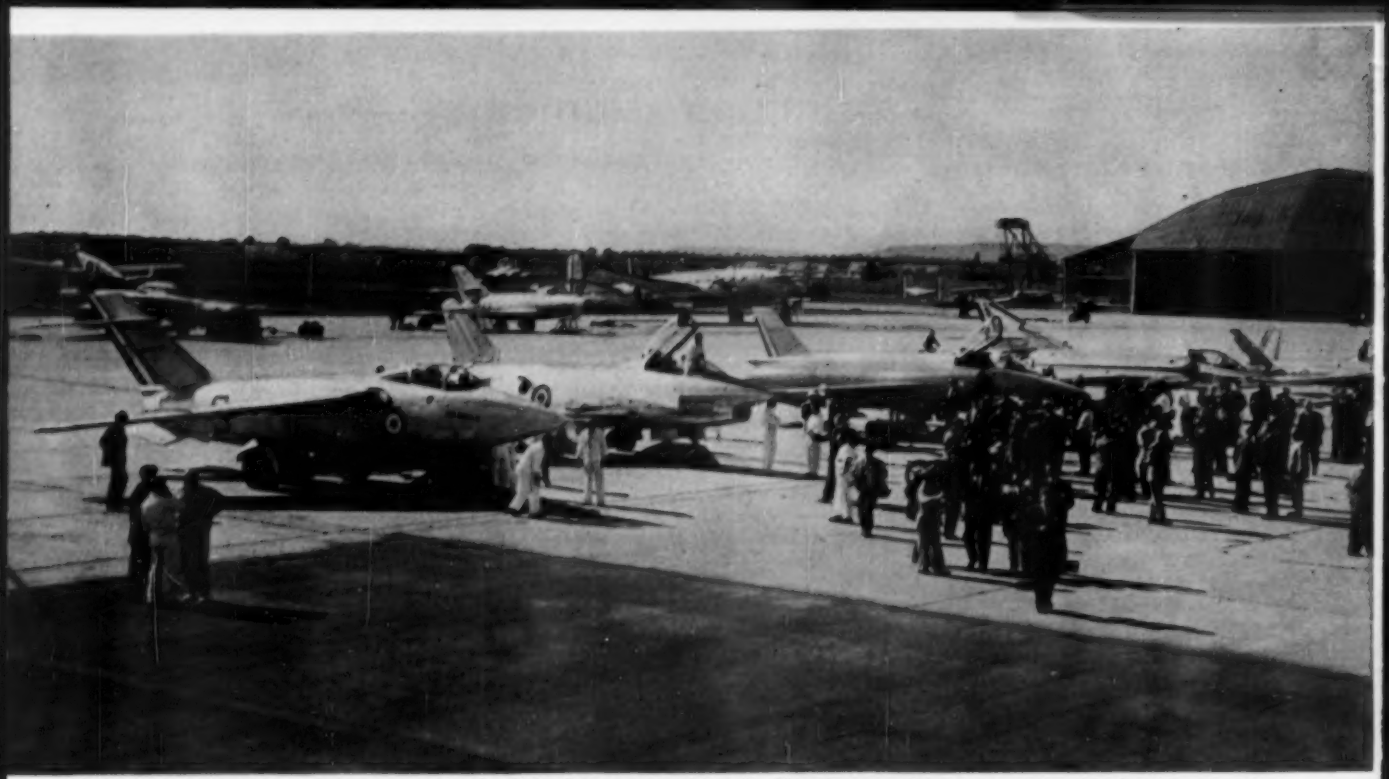
Outside of the military services, it has gone mainly into the rotary-wing fixed base business—now 10 years old. Aircraft Industry Assn. finds 89 commercial operators in North America, flying 380 aircraft. Most of them are Bell 47s, which started the whole thing by winning the first commercial certificate in late 1946. Biggest business: Okanagan Helicopters Ltd., of Vancouver, B. C. Canada, with 25 Bell 47s, 17 Sikorsky S-55s and one Sikorsky S-58.

CAB Warning

Civil Aeronautics Board has warned Los Angeles Air Service, a supplemental carrier, that it must operate a revenue flight within the next 30 days or stand to lose its interim operating authority. As a result of the 1955 CAB decision in the Large Irregular Air Carrier Investigation Case, supplemental carriers must make at least one revenue flight during every two consecutive calendar quarters.

Los Angeles Air Service has not operated a flight during the past two quarters since it sold all its aircraft, leased them back and then subleased them to another carrier. In asking for an exemption from the revenue flight requirement, the company says it has purchased two DC-6s for delivery next May, at which time it plans to resume operations. CAB denied the application but gave the airline a 30-day grace period in which to negotiate for the lease of airplanes to operate flights.

Washington staff



LINEUP AT BRETIGNY includes four of the five light fighters entered in the NATO competition for a strike aircraft. At extreme left of row is Sud Aviation Baroudeur; next are Fiat G.91, Breguet 1001 Taon and Dassault Etendard 6. Etendard 4 is missing.

Fighters Compete for NATO Approval

Lack of power in all contenders leads observers to believe prize will be limited pre-production order.

Bretigny, France—Five entries in NATO's competition for a lightweight tactical strike fighter finally got off the ground on the same day and at the same place in the long-delayed start of their comparative flight trials.

Teams of NATO pilots, flying the missions in rotation, will carry out trials for the next few weeks. Completion of the evaluation is expected early in October depending on weather and aircraft availability. Winner of the competition is expected to be announced late this year after evaluation of the flight reports.

Minor troubles plagued the first day of trials. The Dassault Etendard 4 was briefly out of the running with engine and radio difficulties, and the Fiat G.91 aborted one mission because of smoke in the cockpit.

Entries Lack Power

The five competitors include three specifically designed for the NATO competition: Breguet 1001 Taon, Dassault Etendard 6 and Fiat G.91, all powered by a Bristol Orpheus 3 turbojet rated at 4,850 lb. thrust. They have been joined by two other aircraft which the makers feel can also do the mission: Dassault Etendard 4 and Sud Aviation Baroudeur, both powered by a Snecma Atar rated slightly above 8,000 lb. thrust.

First prize could be a production order for several hundred aircraft, but some observers believe that only a pre-production order will be placed for a limited quantity. The reason is that as design of the competing planes has progressed, they have grown in weight beyond the original 10,000-lb. limitation and are therefore somewhat underpowered. Breguet, Dassault and Fiat have presented variants of their basic designs using the more powerful Bristol Orpheus 12 rated at 6,800 lb. thrust and 8,170 lb. with afterburner. But the Bristol engine is longer and heavier and requires more air and more total fuel to perform the mission. This calls for a major redesign of the airplane.

Consequently the planes presently competing do not represent aerodynamically or operationally the developed version that seems to be needed to perform the original mission. Construction of a series of new prototypes will take time and further delay the program.

Thus the choice seems to be either selecting one of the current crop for pre-production while development of the models continues, or ordering a production batch of an airplane that will in all probability be unable to perform its mission when it reaches service.

Support Role Scored

The mission itself has been bitterly criticized in some quarters as unrealistic. It calls for use of the aircraft against tactical targets—troop concentrations, armored columns, supply dumps, missile or artillery positions—in support of NATO ground armies. It is the last phrase that hurts some of the critics, who feel that army support went out of the manuals when nuclear-tipped missiles went in. They claim that this design and production effort is being wasted on an airplane whose basic concept is geared to a 1945 ground campaign.

But NATO and SHAPE planners argue that the expected threat will come from a numerically superior enemy striking out in force at one or more points along a line of defense. They say the way to prevent this kind of an attack from driving through is to keep the necessary concentrations of material or men from forming. This can be done by tactical strikes against concentrations, forcing the

LANDING BAROUDEUR generates a cloud of dirt as rectractable hooks dig into the ground for braking. The aircraft, which uses skids instead of conventional gear, also utilizes a drag chute for deceleration.

enemy either to break them up or to avoid concentrations in the first place.

The turning issue of this argument is in the assumption of the type of threat. SHAPE sees it as enemy armies, the critics see it as enemy air or missile assault.

Specific requirement for the aircraft is the ability to deliver tactical weapons against ground targets. The plane is required to take off from a grass field or other unprepared surface, and clear a 50-ft. obstacle within 3,000 ft. after releasing the brakes. Climbout is to a relatively low altitude for cruise at 400 kt., followed by a dive descent to the deck and a run into target at Mach 0.95. Return to base is by a similar flight plan.

How Project Started

Origin of the project was in studies made at Allied Air Forces, Central Europe, which developed the idea of the tactical light fighter. SHAPE issued the requirement coincidentally with the start of the U.S. Mutual Weapons Development program. All the NATO nations were told that the U.S. would consider supporting a program endorsed by SHAPE as meeting the NATO requirement.

Design proposal evaluation was assigned to an ad hoc committee formed by AGARD Chairman Theodore von Karman and this group recommended three designs—Breguet Taon, Dassault Etendard and Fiat G. 91—out of the ten proposals submitted. Both French and Italian governments promised to contribute to the support of the program.

Bristol's Orpheus was the only engine that would meet the requirements: all three winning proposals specified it.

PARACHUTE STREAMING inflated behind, the Breguet Taon (Horsefly) rolls to a stop on the concrete strip at Bretigny. Although specifications called for operation from unprepared fields, most of the trials have been conducted from concrete runways.

TAXIING in with canopy lifted, the Dassault Etendard shows its small size, large tires for coping with unprepared fields. Note leading edge flaps in two segments.

and it was in most of the losing design as well.

In 1954 the projects started seriously as international research and development programs under mutual weapons development.

Meantime von Karman had seen that SHAPE would need future technical advice, and organized a permanent advisory committee on the project. There were five subcommittees formed:

- **Mock-up and requirements,** giving guidance to the contractors on design, construction and equipment of prototype mockups.
- **Flight testing,** setting up the current series of trials as well as helping contractors with individual problems of flight test techniques.
- **New developments,** responsible for keeping the weapon system project contemporary with the state of the art. One of this committee's ideas was to bring the Orpheus 12 into the program.
- **Production and logistics,** to get NATO and national cognizance of the production problems of the airplane.
- **Tactics and techniques,** to guide the initial planning of the SHAPE tactical trial program. This program will use the 30 Fiat G.91s now under construction to develop tactical roles and missions for the weapon system.

As was predicted by observers in April, NATO found it necessary to revise its competition schedule; flight trials were originally planned to take place in the first week of August.

The NATO lightweight support fighter program was launched several years ago. It has been financed mainly by U.S. funds. Original plans called for selecting a winning aircraft, then various NATO countries would join in the production of some 1,000.

Officially, no public criticism has been directed at the program. But several defense ministries did tell NATO that unless the program was revised they would not be interested in participating (AW April 29, p. 37).

FIAT G. 91 with underwing stores is shown here in overload configuration. It was developed with strong Sabre-series influence. Company is building 30 airplanes to be used in NATO tactical evaluation of the concept as a weapons system.

AMB's First Major Program Scheduled to Begin This Week

By Philip J. Klass

Washington—First major Airways Modernization Board program will be launched this week when the newly formed agency sends out requests to more than 40 avionics companies for contract bids on a multimillion dollar automatic data processing and display program.

Industry will have 60 days to submit proposals for the construction of an experimental data processing and display system—using existing equipment and know-how—for delivery in January, 1959.

Service Test

After a year of AMB experimentation and modification, the system will then be installed and service tested under actual operational conditions, probably in the New York area.

AMB's air traffic control datamation program is the first of five major programs the new agency is expected to launch in the near future. The others, in their present order of priority, are airports, communications, radar data collection and navigation.

Approximately 100 representatives of more than 40 avionics companies attended an informal meeting here last week at AMB invitation to hear AMB officials give a preview of the program and its objectives.

Program aims at speedy application of many existing computer and data processing equipments, developed for military or commercial use, to accelerate the handling of information used in air traffic control.

Many of the data handling and display techniques now in use date back 15 to 20 years.

AMB's request for bid will outline in broad terms the operational requirements for the ATC datamation system, including:

- **Accept data from variety** of sources, including radar, teletype, telephone, voice radio and military data link.
- **Compute automatically** such things as continuous estimate of each aircraft's position, based on flight plan or position reports, estimated time of arrival into terminal area.
- **Display aircraft position** for en route, terminal area and airport surface movements.

Operational Tests

AMB officials emphasized that equipment must be designed for maximum flexibility to permit modification of control procedures and techniques during the 12-18 months of experimentation that will follow system delivery in January 1959.

Present schedule calls for installation of the equipment in the New York area beginning by about January, 1960. System will be evaluated for en route and terminal area operations using two or all three of the major New York airports, plus a private airport, military base and off-shore naval operations, an AMB spokesman said.

It also will be tied into SAGE air defense system.

Experience gained in these tests will provide basis for a production design version that is scheduled to replace the experimental system in New York area around early 1963.

Similar ATC datamation and display systems may then be programmed for construction and installation at various other major terminals around the country.

Tight Schedule

Concurrent with the initial work on the experimental system, AMB's staff of engineers and operations personnel expect to make analytical and simulator studies of the validity of traffic control and terminal area concepts proposed by the Curtis Committee report to the President on airways modernization needs.

Any changes in operational doctrine suggested by these studies will be incorporated in the design of the experimental system.

To provide guidance to the selected contractor in designing controls and displays that are compatible with traffic controller needs, the board plans to send several traffic controllers now on its staff to work alongside contractor's engineers.

Avionics manufacturers were warned that they must use existing equipments and proven techniques to meet AMB's tough timetable. The contractor's job is to design existing equipment into a system suitable for air traffic control, developing only the black boxes needed for this purpose.

Airways Modernization Board is hopeful that the timetable can be met, particularly since a number of avionics companies have had the ATC datamation problem under study for some time using their own funds. This includes such companies as General Electric, General Precision Equipment, Hughes Aircraft, International Business Machines Corp., Radio Corp. of America and Sperry Rand.

Recognizing the magnitude of the job to be done, AMB has encouraged smaller firms to form coalitions to compete with the industry giants.

Although AMB officials decline to indicate type of contract which will be employed for the development, it is believed that a cost plus fixed fee (CPFF) form will be used to provide flexibility in making system design changes during the program.

Grumman Prices Gulfstream Executive Transport at $700,000

New York—Price of approximately $700,000 will be set by Grumman on its new Gulfstream twin-engine 10-12 passenger turboprop-powered executive transport as delivered to distributors minus completed interiors and with basic navigation and communications equipment, Aviation Week learned last week.

Official announcement is expected to be made during National Business Aircraft Assn.'s annual meeting in Denver, Colo., this week.

Grumman appointed three distributors in the United States who will take orders, receive flyaway airframes and install complete interior and equipment to customer's order (AW July 8, p. 26): Atlantic Aviation Service, Inc., Philadelphia; Pacific Airmotive Corp., Burbank; and Remmert-Werner Corp., St. Louis. Distributors already have accepted some deposits on the airplane for 1959 delivery. First Gulfstream is scheduled to come off Grumman's Bethpage, L. I., N. Y., production line Apr. 7, 1958.

Here is payment schedule for distributors when ordering the airplanes from Grumman:

- **$10,000 deposit when order is placed with Grumman. This gives the distributor a production priority.**
- **Payment of 25% of total cost, minus the deposit, when Grumman assigns a production line number to the airplane, normally 30 days prior to start of actual manufacture.**
- **Second payment of 25% of total agreed purchase price four months prior to delivery.**
- **Final payment, comprising 50% of total price, upon acceptance of the airplane by the distributor.**

Defense Money Squeeze Detailed

New York—Full impact of Defense Department's new contract placements will be felt by the aircraft and other industries in the October-December quarter, and the Fiscal 1958 total of new business will be about $20 billion, according to Wilfred J. McNeil, Defense Department comptroller.

McNeil told the National Security Industrial Assn. last week that the amount of new business placed in July and August was small—in the neighborhood of $7 million—but that the department feels the total direct obligations for Fiscal 1958 will be about the same as Fiscal 1957—over $39 billion.

In the separate area of current expenditures, McNeil did not express any great optimism that the armed forces are going to win the fight to stay below $38 billion by any easy margin. Figures on the expenditure rates for September and October, he said, "will be decisive."

Defense Secretary Charles E. Wilson has set a $19 billion spending ceiling for the first half of the current fiscal year. McNeil says it will not be met unless the September and October rate does not show a significant decline.

With reference to the aircraft industry, McNeil said he hopes substantially all program adjustments have been made. Many industry observers do not share this optimism and McNeil himself added that it is "Quite possible that consideration may have to be given to some further adjustments."

He had this warning for the aircraft industry:

• "**Aircraft industry employment** by the end of August had declined only by about 20,000 to 25,000 from the 909,000 peak in April of this year. A much more substantial decline than this is to be expected when all the necessary actions, already announced, have been taken. . . .

"Overtime in the aircraft industry is down significantly . . . but not down quite enough."

Earlier, McNeil said that in the January-March quarter of this year overtime payment "in a surprising number of aircraft plants accounted for more than 15% of the total payroll, and in one or two plants reached 20% of total payroll."

McNeil pointed out that this year's imposed ceiling of $38 billion on expenditures is only about 1% less than the Fiscal 1957 rate of $38.4 billion. In the latter part of Fiscal 1957, however, the Defense Department was sending out checks at the rate of $40 billion a year and the adjustment to this figure amounts to about 5%.

Atlas Test Firing

Patrick AFB, Fla.—Firing of a second Convair-built Atlas intercontinental ballistic missile here last week was not intended as a test of the weapon's speed or altitude capability.

The Atlas apparently was fired for data on engine performance. It carried a sharp nose cone, as seen by observers on nearby beaches, and it probably was scheduled for destruction as soon as the power units had finished their job. A blunt nose would be necessary for high speed re-entry to the atmosphere.

Witnesses said the missile began to drift rather than follow its assigned flight path after the first-stage rockets had burned out. About the time the second-stage should have taken over, the Atlas nosed downward with flame and smoke in its trail. At this point, the missile was destroyed from the control point.

Apparent trouble was that too much fuel was pouring into the powerplants. The excess fuel first ignited, then choked off the motors.

Despite its short duration, the flight produced significant data and was termed a success from an engineering and technical point of view. Reason for the abort, which technicians have isolated, was not the same as that which caused the destruction of the missile in the first Atlas firing (AW June 17, p. 27).

Firing was witnessed by Donald A. Quarles, Deputy Secretary of Defense.

Missile Delegates Are 'Watching, Waiting'

Washington – Representatives of about 30 industrial concerns attended an organization meeting of the National Missile Industry Conference last week. A proposed certificate of incorporation and by-laws were offered, disclosing that the permanent name of the proposed new group will be the National Rocket and Missile Industries Assn.

Delegates queried by AVIATION WEEK indicated that most of the companies have a "watch-and-wait" attitude toward the new group. These men said they were uninstructed and merely are reporting their observations to company management. The observation was made that only two missile prime contractors were represented, and one of these had asked the promoters for an invitation to attend.

This led to speculation that NMIC possibly will be primarily an organization of subcontractors and suppliers in the missile and rocket area. Some of the delegates at the first session feel also there is a promotional tieup between the organization and Missiles and Rockets magazine, although the magazine editors who had signed letters in behalf of the effort (AW Sept. 23, p. 32) left the premises before the meeting got under way.

Kendall K. Hoyt, a Washington publicist who served as moderator of the meeting, told AVIATION WEEK there is no longer any connection between NMIC and Missiles and Rockets. He said the meeting left the organizing group of missile component manufacturers standing on their own feet.

Hoyt, who has made a career of organizing Washington promotional offices for such groups as the Aircoach Transportation Assn. and the Independent Air Transport Assn., says he is now serving as the acting secretary of NMIC.

He said no financial arrangements have been made but that he is glad to contribute his time if it serves a good purpose in launching NMIC.

Hoyt contends the association will not conflict with existing organizations, particularly the Aircraft Industries Assn., and that there is a need for a clearing house on missile industry information.

He claims that government agencies say they have difficulty obtaining sound statistics on the industry and that NMIC will fill this void.

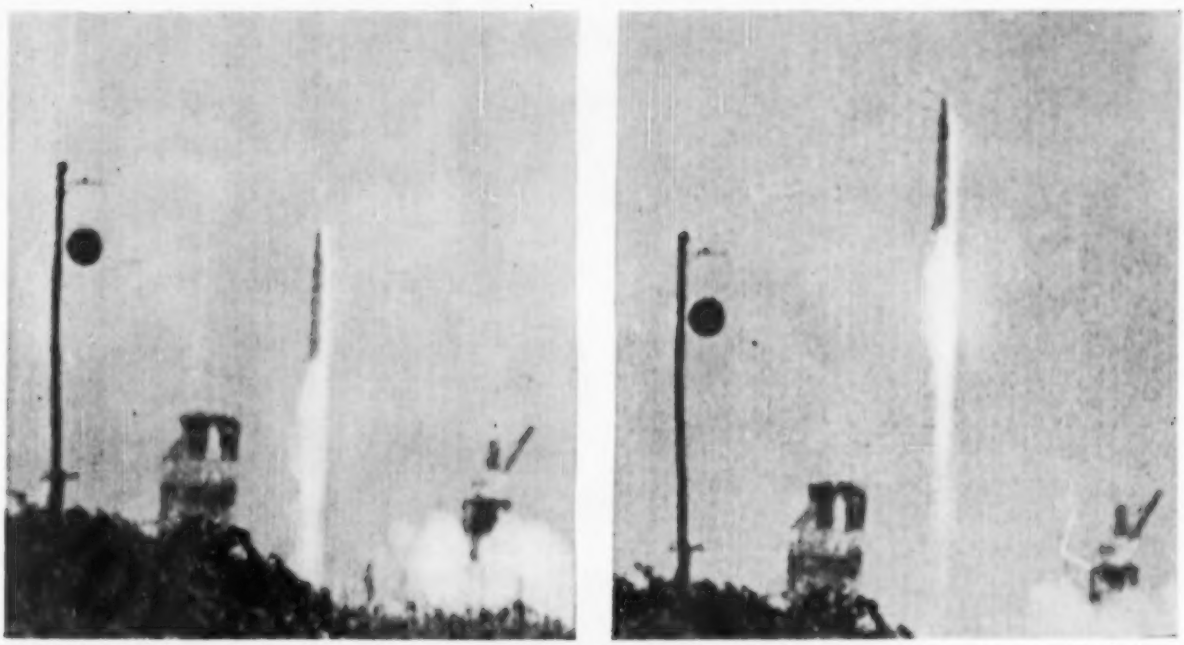
Representatives were present at the first meeting from Navy's Bureau of Aeronautics, Army Ordnance Corps and USAF's Office of Scientific Research and Air Materiel Command. A second meeting will be held on October 22.

British Want Navaid Tests; U.S. Resists

Montreal—Adoption of an international standard long range navigation system is five to ten years away, in the opinion of many delegates to Sixth Communications Division Meeting of the International Civil Aviation Organization.

U. S. and Great Britain basically disagree on approach to both short and long range navigation. British delegation is pressing for an early international conference to evaluate available systems because Decca short range system is in operation and Dectra long range system is expected to complete trials within the next nine months.

U. S. delegation is resisting any move for an early international conference because domestic evaluation of the three long range, ground based systems it has presented—Navarho, Loran C (Cytac) and Omega—is expected to take three to six years.



DOUGLAS THOR leaves the launching pad in its successful firing from Patrick AFB, Fla. Thor, which employs a waffle design to add strength to the airframe, traveled at least 1,500 mi. Firing boosted Thor's position in competition with Army's Jupiter.

Successful Thor Bolsters USAF Hopes

By Claude Witze

Washington—Successful firing of the Douglas-built Thor intermediate range ballistic missile has bolstered USAF confidence there will be no marriage of Thor with the Army-developed Jupiter IRBM and that Air Force's Ballistic Missile Division will proceed with development and production of the Douglas design. In a firing, termed "more successful than we hoped for," the Thor traveled at least 1,500 mi. from Patrick AFB, Fla., on Sept. 20.

On the day of the successful firing, it was disclosed that the Army Ballistic Missile Agency at Redstone Arsenal already has altered the basic structural design of Jupiter to employ the materials and fabrication techniques used on Thor. AVIATION WEEK learned that Thor's structure basically employs a waffle-design, adding strength to the airframe much after the fashion of corrugations in the sheet metal employed in roofs and similar structures.

Redstone Visits Douglas

About three months ago, according to a reliable source, a team from Army's Redstone Arsenal visited the Douglas plant in California to examine the basic structure of the Thor. Army Ordnance Corps immediately ordered changes in Jupiter to pattern it after the more sophisticated USAF missile.

It was pointed out that Air Force work on this problem of structural design, key factor in the sensitive ratio of fuel weight to total weight, is as old as the airplane itself. In the missile field, USAF has been working on improvements for use in missile development ever since World War II and the achievements were being used in USAF's intercontinental ballistic missiles—Atlas and Titan—as well as Thor before they were adopted by the Army.

Further savings have been effected by USAF's work on rocket engines, making it possible for Army's Jupiter to use the same engine developed for Thor. This unit, product of the Rocketdyne Division of North American Aviation Inc., also is one of the power units installed on the Convair Atlas ICBM.

Thor's successful firing was made on the fourth attempt to get the missile away from a launching pad at Patrick.

First shot got only a few feet off the pad before being destroyed by fire. Second shot was prematurely destroyed in flight by the range safety officer due to faulty ground instrumentation. Third shot went only a few miles before going off course.

The fourth attempt was made at a crucial time in the deliberations of the Defense Department's three-man committee which was trying to decide on the relative merits of the Thor and Jupiter designs and how their best features could be welded into a single weapon system.

After about a week of closed sessions at the Pentagon, it was reported the committee stood with its anticipated three-way split. Maj. Gen. Bernard A. Schriever, commander of USAF's Ballistic Missile Division, favored Thor. Maj. Gen. John B. Medaris, chief of the Army Ballistic Missile Agency, stood firm for Jupiter. William H. Holaday, special Assistant Secretary of Defense for Guided Missiles, was not committed.

In the early hours of the day Thor was scheduled to fire, Holaday hurriedly left the Pentagon and was flown to the Florida test station. He was joined there by Donald A. Quarles, Deputy Secretary of Defense, who was at Patrick for a short vacation. Quarles is a former Secretary of the Air Force and former Assistant Secretary of Defense for Research and Development. He is a recognized expert on guided missiles.

Wilson View

Pentagon observers last week expressed confidence that Holaday, with some counsel from Quarles, will settle the IRBM question, probably favoring the USAF-Douglas team.

Defense Secretary Charles E. Wilson remained aloof from the discussion but acknowledged on the eve of the Thor demonstration that he had granted the committee more time to reach a conclusion. He hoped to announce his decision before he leaves office next week.

Another possible factor in the final decision is the rejection by Wilson of a

types of transmission equipment.

New unit occupies .67 cubic inches of space and is smaller and lighter than current 50 watt transmitters used for similar duty. It transmits in the 215-235 mc range with frequency stability of plus or minus 0.01% up to 71 de-

Curtiss-Wright's Hurley Replies To Rep. Hebert Contract Charge

Washington—Question of whether

Farside Rocket Displayed

Four stage solid propellant rocket for launching from a balloon in Project Farside is displayed at American Ordnance Assn. meeting in Detroit. Ford Motor Co. subsidiary, Aeronutronic Systems, Inc., is prime contractor for system designed to reach height of 4,000 mi. First stage is four Thiokol Recruit rockets, the second is a single Recruit. Third is composed of four Grand Central motors now used in ASP sounding rocket, and fourth stage is a single ASP motor (AW July 22, p. 29).

suggestion that the Chrysler Corp. has plans to build a new missile factory in Huntsville, Ala., near the Redstone Arsenal (AW Sept. 23,p.29).

Queried by AVIATION WEEK, Wilson said he did not know of such a Chrysler proposal although, "According to some people they have got a subsidiary there now."

Wilson added that a new facility should not be needed for the IRBM and said he would "look with a cold and fishy eye" on any plan to build a new plant.

ICBM Defense?

Secretary Wilson also took note of recent claims by Army partisans that an effective defense against the ICBM is entirely possible, a viewpoint that clashes sharply with more pessimistic statements from USAF experts who are charged with responsibility for air defense.

"I am afraid," Wilson said, "there is a certain amount of talk going on . . . by people trying to stake out a claim for a future development position."

There is some possibility that the IRBM decision will be made after Wilson leaves the Pentagon and turns his job over to Neil H. McElroy. On the day of the successful Thor firing, McElroy was a visitor at Gen. Schriever's headquarters in California. Late this week, he is scheduled to spend a day at Redstone Arsenal. In between, he will visit plants of major aircraft manufacturers and USAF installations.

Long-Thrust Rocket Used in Temco Drone

Bartlesville, Okla.—Solid propellant rocket motor which powered the Temco XKDT-1 drone in its first flight represents a major scientific breakthrough, according to Phillips Petroleum Co.

Flight of the Temco drone (AW Sept. 16, p. 30) marks the first successful use of rocket-powered target drones which require long periods of sustained thrust, Phillips said. The rocket motor was designed and built by Phillips and burns a Phillips solid fuel made from "readily available petrochemicals."

In developing the XKDT-1 rocket motor for Temco, Phillips says it solved these problems:

- **Obtaining flight duration** of more than eight minutes.
- **Using solid fuels that provide** in the same motor both initial boost and subsequent sustained thrust without power interruptions.
- **Controlling heat to protect** electronic and metal parts from damage.
- **Providing satisfactory** light-weight rocket metal parts.

The first motor was ready for flight test six months after performance requirements were established. Phillips says this short development time was made possible by previous achievements of company scientists who have developed a series of solid propellant rockets that feature a variety of thrusts and durations.

New Unit Increases Telemetering Range

Dallas—New 200 watt PM transmitter has been developed by Texas Instruments to increase effective range of FM/FM telemetering. New transistorized equipment is complete in a single unit and requires no amplification of output.

Texas Instruments points out that extra power will be especially valuable for telemetering the terminal phase of missile flights where weak signals are blacked out by background noise. The company says greater power will extend transmission range considerably beyond line-of-sight limits imposed by present

types of transmission equipment.

New unit occupies .67 cubic inches of space and is smaller and lighter than current 50 watt transmitters used for similar duty. It transmits in the 215-235 mc range with frequency stability of plus or minus 0.01% up to 71 degrees C.

Higher frequencies are possible with slight modification, and modification can lower power output to as little as 25 watts.

Operation at 200 watts requires 12 cfm of external cooling air. Integral heat sink provisions stretch out the transmitter's operation during periods of rapid heat build-up, suiting the unit to such missile test phases as re-entry into the atmosphere, according to Texas Instruments.

Australian Line Orders Lockheed Electras

Washington—Ansett-Australian National Airways last week ordered four Lockheed Electra turboprop transports at a cost of $12 million including spare parts.

Lockheed Aircraft Corp. said the order brings the total Electra sales to 141 aircraft.

Deliveries of the transports to Ansett-ANA are scheduled to begin in December, 1958. The aircraft will carry 66 passengers in deluxe custom seating, plus a six-seat lounge. They will be equipped with weather radar and powered by four Allison Model 501 turboprop engines, developing 3,750 hp. each, and Aeroproducts four-bladed propellers.

The merged Ansett-Australian National Airways routes cover 17,844 miles in Australia and Tasmania.

Soviets Claim Records for Tu-104A

Moscow—Russia is claiming new speed and lift records for its Tu-104A twin-jet transport.

On its homeward flight from the United States, the Soviets claim that a Tu-104A operating in the USSR reportedly:

- **Reached an altitude of 11,221 meters (36,814 ft.) carrying 20,053 kilograms (44,217 lb.) of cargo—"equal to 260 passengers."**
- **Flew 2,000 kilometers (1,242 miles) with two metric tons (4,410 lb.) of cargo at an average speed of 897.498 kilometers per hour (557.34 mph.).**

The achievements will be submitted to the Federation Aeronautique Internationale (FAI) for certification as world records for this class of jet transport aircraft.

Curtiss-Wright's Hurley Replies To Rep. Hebert Contract Charge

Washington—Question of whether Curtiss-Wright Corp. "bailed out" a private concern — Studebaker-Packard Corp.—with government contracts or sustained a private concern in the national defense interest continues to be disputed.

At July hearings, Rep. Edward Hebert (D.-La.), chairman of the House Armed Services Investigating Subcommittee, charged that "it cost the taxpayer $25 million to switch" the overhaul of GE J47 engines from the General Electric Co. to Studebaker-Packard for the specific purpose of sustaining the private firm (AW July 22, p. 25).

Hurley Reply

In a detailed statement challenging this, Roy T. Hurley, chairman of the board and president of Curtiss-Wright, noted that his firm "devoted several months in trying to work out a plan to take over the Studebaker-Packard defense contracts, conserve large defense facilities, save Studebaker-Packard from bankruptcy, keep 30,000 people employed by Studebaker-Packard, its dealer organization and suppliers from losing their jobs, reassure a million Studebaker-Packard car owners that their automobiles still had good value and give hope to 120,000 stockholders that their company had a fair chance of survival."

Hurley reported that after Curtiss-Wright took over the management of Studebaker-Packard under the name of a wholly-owned subsidiary—Utica-Bend Corp.—the firm received new defense contracts totaling over $95 million.

Rep. Hebert retorted that Hurley's report "clearly established the fact that Studebaker-Packard was saved from bankruptcy and 'bailed out' by Curtiss-Wright at the expense of the American taxpayer through the medium of defense contracts. . . . I was in error in one detail. . . . Mr. Hurley's statement indicates that instead of costing $25 million to the taxpayers, the deal really cost many millions more. . . . Mr. Hurley's statement admits in excess of $95 million for contracts directly attributable to the Studebaker-Packard manipulation."

Hebert Objection

"I readily admit," Hebert continued, "that saving Studebaker-Packard was good for the economic position of the nation at the moment; but I cannot agree that a private industry should have been 'bailed out' contingent on exacting defense contracts as the price."

In taking over the Studebaker-Packard Corp. in the name of the Utica-Bend Corp. subsidiary, Hurley said Curtiss-Wright agreed to this financing:

- **$25 million advance payment** of 12 years' lease of two Studebaker-Packard plants.
- **$8 million for purchase** of work in process.
- **$1.8 million to assume** Studebaker-Packard's investment in the Aerophysics Development Corp., manufacturers of the Army's Dart missile.

Hurley said Curtiss-Wright agreed to these investments "provided it received the support of the Department of Defense in the amounts needed to maintain the defense facilities and to attain the successful and economical operation of the plants."

Contracts Acquired

Included in the $95 million in new defense business acquired by the Utica-Bend Corp., after its incorporation by Curtiss-Wright were:

- **$20 million for the Army's Dart.**
- **$12 million for production** facilities for Pratt & Whitney J57 components.
- **$20 million in additional** subcontracts from Ford Motor Co. for J57 parts.

Noting the expected phase-out of J57s, Hurley declared: "We expect the Defense Department to provide other business to replace the lost J57 production."

Employment Decline

Washington—Impact of defense spending cuts on aircraft industry employment (AW Aug. 5, p. 26) has begun to be reflected in Bureau of Labor Statistics figures and Labor-Commerce Department reports.

Preliminary BLS figures for July released last week show a drop of 6,900 workers from industry's all-time peak of 909,100 last April. Average employment for 1956 was 800,000.

Labor-Commerce reports for August note that "employment in the aircraft industry showed its first substantial cutback since the recent uptrend which began a year and a half ago," but gave no figures. Following are BLS figures from last March:

- **March** **908,600**
- **April** **909,100**
- **May** **906,900**
- **June** **905,600**
- **July** **902,200**

Navy Takes Firm Stand on Ban Against Contract Pilot Training

By Katherine Johnsen

Washington—Navy intends to stand pat on its long-time position against contract school training of its pilots, despite strong pressure by the Aeronautical Training Society.

The society's position is strongly buttressed by a study made for the Navy by Robert Heller and Associates, Cleveland industrial consultant firm, completed in December, 1955, but released only last week. The study maintained:

- **Use of contract schools** instead of the Whiting Field facility near Pensacola, Fla., "could" result in an annual saving of almost $7 million in Navy's primary training program.
- **"Quality of flight** training provided at contract schools compares favorably with Navy training and is quite possibly superior."
- **"Quality of formal military training** provided at contract schools compares favorably with that given by the Navy . . . A satisfactory military atmosphere can be developed and maintained at contract schools . . . There is more enthusiasm for military service as a career among students at contract schools than among Whiting Field students."
- **Use of contract schools** for primary pilot training "may" increase over-all military strength by the fleet assignment of Navy personnel now engaged in primary training duty and utilization of the instruction talents of pilots who, because of age or other reasons, are not naval officers. "The contract school system, far from reducing the nation's military strength, tends to broaden the base of that strength . . ."

Navy said it had considered the study, which cost $40,000, as an advisory and working paper for use within the Navy but released it after pressure from ATS.

Study Aim

The purpose of the Heller study, it said, was to furnish specific financial data on one phase of the Navy's pilot training program, primary training, so that the Navy might evaluate this factor against others. It maintains that Heller went far beyond its contract area in making over-all recommendations.

Navy's objections to the findings of the Heller report are these:

- **Flight training is a "specialization"** of a naval officer. The primary interest of the Navy is military training, and this can only be accomplished from contact with a naval officer flight instructor.
- **Heller report considers** only savings that might be made in one segment of pilot training, without reflecting the additional costs that might be involved in the total pilot training cost because of this type of training. Admitting that only the "roughest" figures are available, Navy estimates that the total cost of training of a naval fighter pilot is between $100,000 and $120,000 cheaper than the training of a comparable USAF fighter pilot.
- **Although the Heller report** recommendations for contract training might have some validity in a period of expanding training activity, they have none in the current period of retrenchment. Navy notes that in its estimates of savings through contract training, the report does not take into consideration the cost of closing down and maintaining established Naval facilities and the cost of additional facilities that would be required at new contract schools.

ATS Writes Wilson

ATS President S. J. Solomon has written Defense Secretary Charles Wilson urging implementation of the Heller recommendation for Navy contracting for primary pilot training. Noting that USAF has reduced its contract, Solomon said, "We feel that an unprecedented opportunity is now available to the Navy to utilize the services of two or more primary flying school contractors who now find their services to be excess to the needs of the Air Force."

Navy, however, is confident that its decision against contract school training of its pilots, will not be overridden for these two reasons:

- **Navy's new plan** to compress primary pilot training will make savings far in excess of those contemplated in the Heller report. Navy's goal is to cut the period from 24 to 16 weeks. But the major factor of the plan will be to introduce flight training earlier and cut back the period of purely pre-flight instruction. Since the largest volume of "wash outs" occur in flight instruction, Navy estimates that major savings will result by having the "wash outs" occur earlier.
- **There would be too much** congressional pressure against closing a major complex of the Pensacola base.

British Names as Complex as Missiles

London—British missile code names originally were based on two words, the first a color describing the type of guidance system and the second a word assigned to the project. Typical examples were Fairey Fireflash which was Blue Sky and de Havilland Firestreak which was Blue Jay. Bristol Bloodhound was Red Duster, English Electric Thunderbird was Red Shoes, Vickers infrared air-to-air Type 888 missile was Red Dean. Other examples: Red Hawk and Blue Boar. Elaborate designation even included system for component coding but is believed to have broken down in practice and has been abandoned as designation system.

News Digest

Edgar Schmued, Northrop Aircraft Corp. vice president for technical matters, will resign effective Oct. 15, and then will act as a consultant to Northrop. Schmued will establish his own research and development firm, the facilities of which will be used in his consultant work with Northrop. Schmued's new company will work in several fields in addition to supplementing Northrop's advanced programs in weapon systems development.

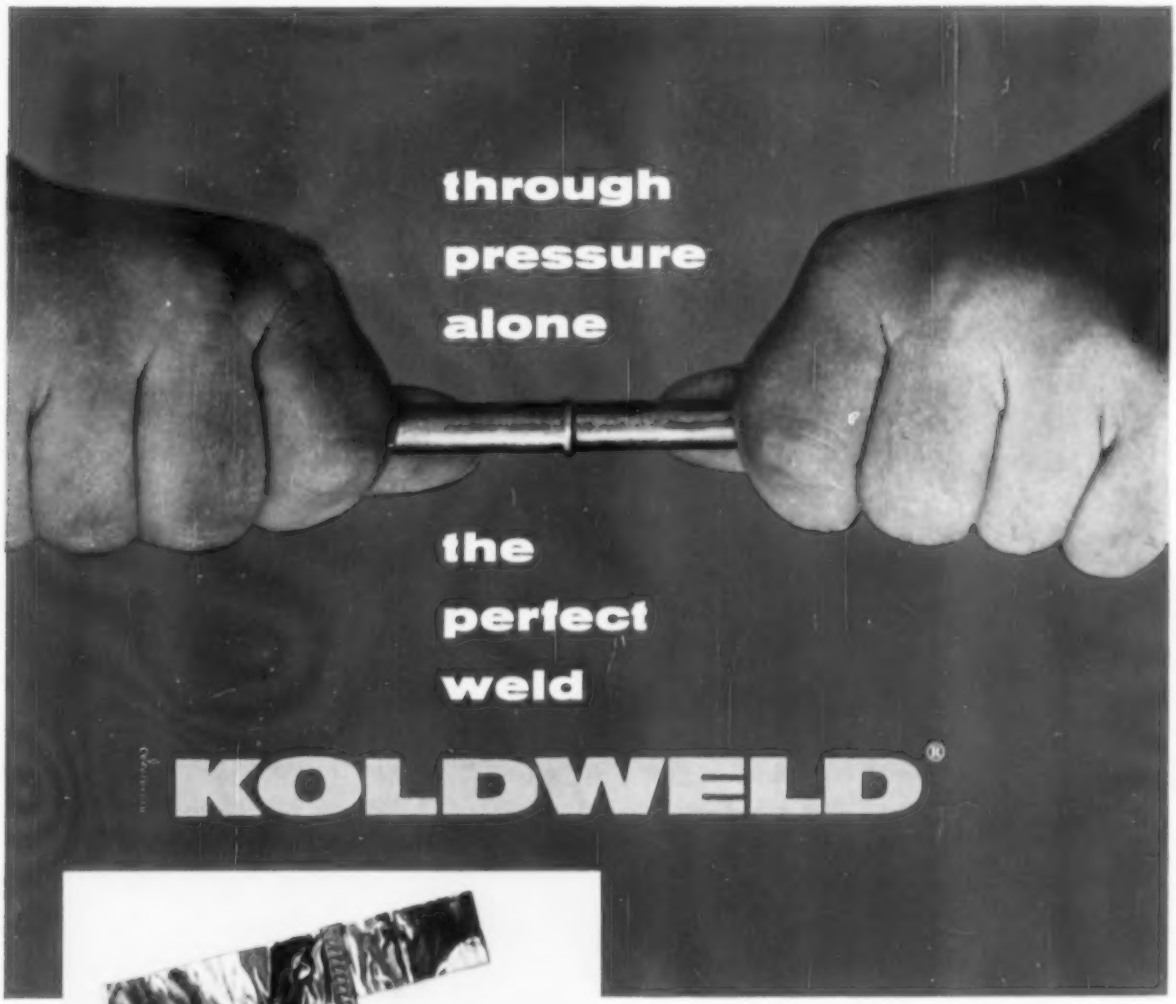
General Electric established a T64 project to develop the aircraft-helicopter gas turbine engine in the 2,600 hp. class. Navy awarded $58 million contract for development of the engine last May.

Beech Aircraft Corp. received follow-on production contract for 1,700 gal. jettisonable fuel tanks for B-47 bombers. Contract was for $10 million.

B. F. Goodrich Aviation Products acquired land and buildings formerly owned by West Coast Loading Co. at Rialto, Calif., for facility for research and development in rocket propellants.

Convair San Diego will soon start a $2,500,000 renovation of its engineering buildings which house some 4,500 personnel. Construction bids are due Oct. 10, with 15 months estimated for completion. Architects are Paderewski, Mitchell and Dean of San Diego. Eric Winchester is Convair project engineer.

Solar Aircraft Co. received a $4,500,000 contract from Air Materiel Command for turbine powered airborne generator sets and spares. Company's 50 hp. Mars turbine is basic unit of the sets, which will be installed in KC-97 tankers. Contract is a follow-on to those under which sets already have been built and installed in seven air refueling squadron airplanes.



the bond results from close inter-atomic contact of the two metallic surfaces

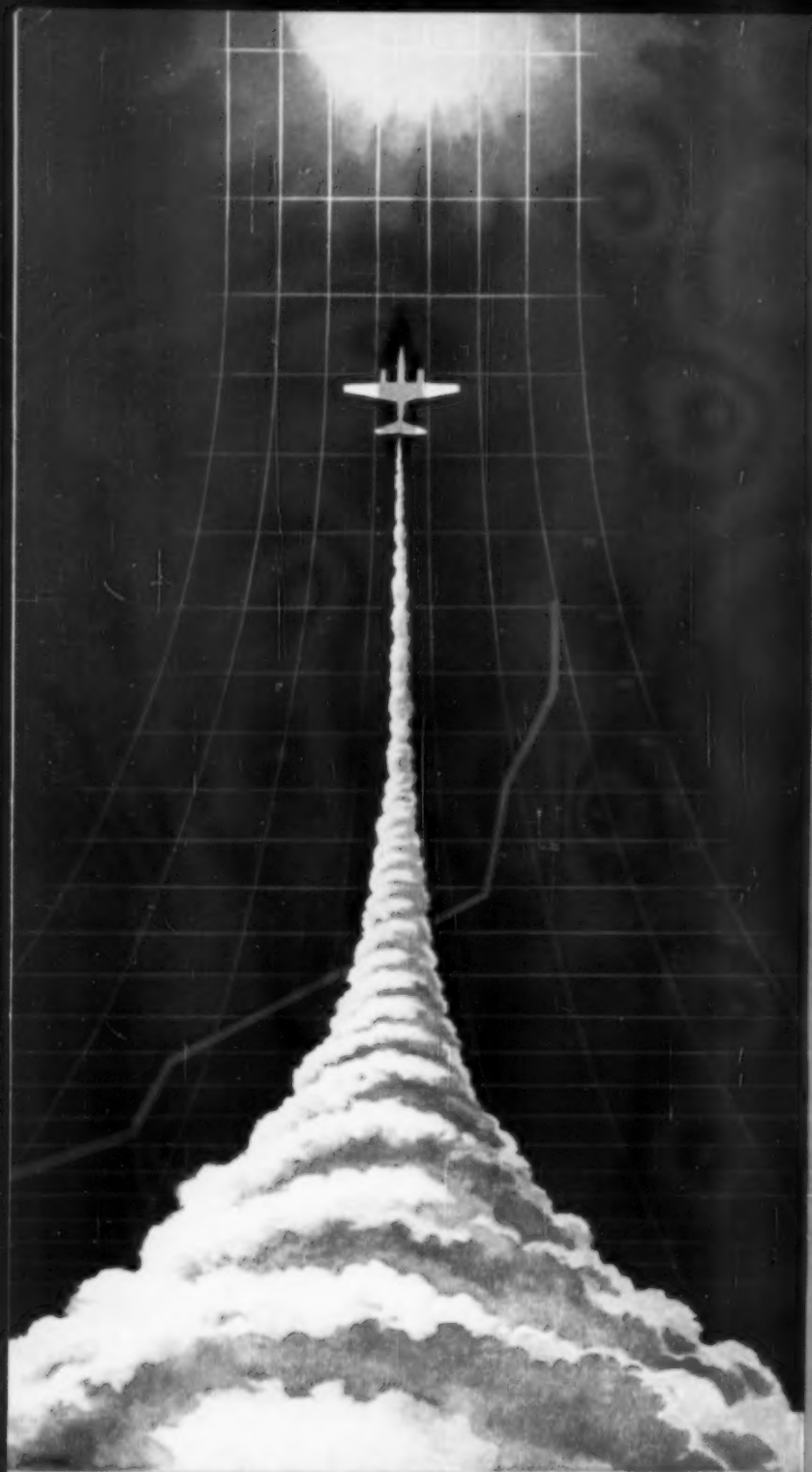
A revolutionary process of welding non-ferrous metals and alloys without heat, electrical current, filler material or fluxes. The bond results from close inter-atomic contact of the two metallic surfaces. It has excellent electrical conductivity and tensile strength often exceeding that of the parent metal. Koldweld is now available to industry. In addition to supplying standard hand and power operated tools, the newly formed Koldweld Division of Kelsey-Hayes is now able to offer technical assistance in the design of dies and fixtures readily adaptable to conventional metal fabricating equipment under a license agreement.

Koldweld Division, Kelsey-Hayes Co., Utica 4, N.Y.

KELSEY-HAYES

Automotive, Aviation and Agricultural Parts • Hand Tools for Industry and Home

15 PLANTS: Detroit and Jackson, Mich.; Los Angeles; McKeesport, Pa.; Springfield, Ohio (Speco Division); Utica, N. Y. (Utica Drop Forge & Tool Division); Davenport, Iowa (Farm Implement and Wheel Division); Windsor, Ont., Canada.



Avco makes things better for America...

Avco

Avco today

Avco's Lycoming raises the ceiling for business

Today, business is climbing, literally, to new heights. Part of the story is the executive mobility made possible by a growing reliance on faster, more powerful twin-engine corporate and utility aircraft.

Business got its first power plants from Lycoming. Today, more Lycoming engines roar in twin-engine executive aircraft than any other engines in the world. And Lycoming's engineers are developing new, light, supercharged engines and gas turbines . . . to keep business soaring, to hasten America's progress, to make America stronger.

THIS IS AVCO

Avco today is a diversified organization whose products include aircraft power plants and structures, electronics for defense and industry, and specialized home and farm equipment. Avco's divisions and subsidiaries are:

Lycoming—aviation, marine and industrial power plants . . . Crosley—electronics and aircraft structures . . . American Kitchens . . . New Idea and Ezee Flow—specialized farm equipment . . . Research and Advanced Development . . . Crosley Broadcasting Corporation . . . Moffats, Ltd. (Canada)—commercial gas and heating equipment.

Scientists interested in unusual opportunities for advancement can grow with Avco.

Avco Manufacturing Corporation
420 Lexington Avenue, New York , N. Y.

Britannia Delays Hit BOAC, Northeast

Because aircraft won't be ready for Florida season, U. S. airline sets conditions for retention of order.

By Glenn Garrison

New York—Certainty that the new British-certificated long-range Britannia will not arrive on Northeast Airlines' Florida route in time to expand the carrier's beachhead in the highly competitive market this season has caused Northeast to demand new conditions if the deal is to go through at all.

Northeast, sole announced U. S. buyer of the big turboprop, will go ahead with purchase plans only if new arrangements are worked out with Bristol Aeroplane Co. These would have to include extension of new delivery date to next October and Civil Aeronautics Administration certification by May 1.

Fall Delivery

Northeast originally had hoped to get its first two Britannias in October, the final three in late November, and a third in December. Now that the plane clearly will not be available for this winter's peak traffic on the Florida run, Northeast doesn't want it until next fall for the next peak season. And the order is contingent on full CAA certification by the May 1 date.

The engine icing problem, not the landing gear modification CAA required in Northeast's Britannias (AW Aug. 5, p. 67) is the main uncertainty about U. S. approval. Gear problem has been licked and the modification is considered routine, although it adds about 500 lb. to Britannia's gross. No other Britannia customer is involved in the landing gear fix.

Northeast also will have to rearrange its bank financing to adjust to the delay.

Bristol's position was to be clarified late last week at simultaneous press conferences scheduled here and in London in the wake of these developments in the Britannia situation:

- **British Overseas Airways Corp.** officials publicly complained about costly delays in delivery of the turboprop airliner. BOAC also noted that engine icing problems had not been finally solved.
- **Britain's Ministry of Transport** and Civil Aviation approved certification of the Britannia 312 and 313, but noted that operators are advised to avoid prolonged flight in certain conditions because of possible icing effect on the Proteus 755 engines. Flameouts of Proteus 705 in smaller Britannia 102 developed during proving flights in early 1956 and have been a major cause of delays in Britannia 312 production.
- **Bristol** issued a statement defending the airplane and called it capable of performing all commercial operations for which it was designed.
- **BOAC** received its first 312 and the plane was scheduled to arrive in this country last Saturday for proving flights.
- **El Al Israel Airlines** took delivery of its first Britannia.
- **Aeronaves de Mexico** expected its first Britannia on schedule next month.
- **Canadian Pacific Airlines** won't get its initial Britannia this month as originally scheduled, now hopes for January, 1958, delivery.
- **Howard Hughes** was reportedly still negotiating with Bristol for Britannias for Trans World Airlines. BOAC is said to be willing to release four of its Britannia 312s to TWA if the British government asks it to. Transfer would probably involve payment by TWA of a premium of $2.1 million each over and above the cost of the planes to compensate BOAC for loss of revenue. Cost of the airplanes without spares is $3,650,000. TWA refused comment on the negotiations.
- **Peter Masefield,** managing director of Bristol, was scheduled to arrive in New York last Friday for the press conference here on the Britannia situation.

Bristol Defense

In announcing approval of Britannia's certification, the Ministry noted that a special committee set up to cope with the Proteus icing problems still is working toward a permanent solution.

"Although there have been these problems with the engine," the Ministry said, "the Britannia is a safe and in many respects an outstanding aircraft."

Bristol's fix of the Proteus so far includes a platinum glow plug to re-ignite the engine if flameout develops, and new spacing of entry guide vanes. Icing difficulties have been attributed to design feature which reverses flow of air inside the engine.

BOAC was to have made use of the transatlantic flight last week to test, among other things, the performance of the Proteus if the special icing conditions could be found on the route.

If problems do develop on the Atlantic, BOAC says it won't use the 312 in passenger service over the route. The carrier isn't expecting any trouble, a spokesman said, but "we want to make quite sure."

Basil Smallpeice, BOAC's managing director, complained this month that late deliveries of Britannia 102s and 312s had caused his airline great financial loss. Delivery delay in the 312 alone, Smallpeice said will cost his airline $5¼ million and might put it in the red instead of the black this year.

BOAC's first transatlantic Britannia service was expected to begin last April, now may be inaugurated in early 1958. Smallpeice estimated losses at $700,000 yearly for each 312 replacing older aircraft and $2,100,000 yearly for each 312 added without replacing another plane.

BOAC also has criticized the Proteus icing troubles, reported 49 unscheduled engine removals in the Britannia 102s including 16 removals caused by icing.

Other Troubles

In addition, BOAC's 102s, according to the airline, have suffered a series of unrelated faults, mostly in hydraulic and electrical systems.

BOAC said the prototype 312 was 7% below minimum range requirement.

Smallpeice's criticisms caused a furor of attacks on Bristol from the British press.

BOAC and Bristol are working amicably together on Britannia problems, however, the airline reports, and BOAC has "a great deal of faith in both Britannias."

El Al Israel airlines has received its first Britannia 313, expected delivery of the second last week and of the third by the end of October. El Al hopes to put a scheduled Britannia on the North Atlantic by Dec. 1.

The Israeli carrier expects no problems with the Proteus on its route, will run its first proving flight next month. Its first airplane is 2% over specifications in performance, El Al says.

Canadian Pacific Airlines was supposed to get its first Britannia this month, now hopes for initial delivery next January. CPA's order totals six.

Aeronaves de Mexico, however, expects the first of its two Britannias to arrive at New York International Airport about Oct. 23, on schedule.

Bristol acknowledged in a statement that its long-range Britannia had for the previous ten days "been the subject of much comment which has in-

evitably given rise to speculation and alarm at home and overseas."

Despite "great public interest," Bristol continued, the manufacturer had withheld comment "partly to avoid controversy and partly because several important factors about the Britannia were nearing the point of decision. Following today's statement by the Minister of Transport and Civil Aviation it becomes timely to . . . put the facts about the Britannia in correct perspective."

In regard to engine icing, Bristol's comment cited the Ministry's statement and the plane's "full and unrestricted certificate of airworthiness." Bristol noted that the Air Registration Board had just extended the authorized overhaul life of the earlier Proteus 705 from 850 hr. to 1,050 hr. and reported that recent flight trials have proved production Britannias capable of meeting contractual range requirements in all respects. "The planes," Bristol said, "are not, as was inferred from performance of the prototype, deficient to the extent of 7%. Thus there is no longer any reason to suppose the aircraft lacks the range necessary for regular nonstop services on the North Atlantic."

Range deficiency of the prototype, a Bristol spokesman told AVIATION WEEK, was due to drag not present in the production airplanes and no modifications of the latter were necessary.

Bristol's statement said the icing problem "though intractable is well understood."

The Ministry's announcement refers to prolonged flight in cloud, at altitudes above 16,000 ft. in a narrow band of temperature about the freezing point and in heavy concentrations of water or ice, as combined conditions to be avoided. It cites the relevant flight manual, "an integral part of the certificate of airworthiness," as expressing this advice to operators. The advice is not a mandatory limitation, the Ministry pointed out.

Icing Conditions

Specifically, the combined conditions that may mean trouble are clouds, ambient temperature between 0 and −8C, altitude between 16,000 and 22,877 ft., standard atmosphere between plus 13 and plus 22, and ground water level content of 13 grams to one cubic meter.

Ministry's approval covered recommendation of the Air Registration Board that a normal certificate of airworthiness for public transport be accorded the Britannia 312 and 313 series.

Sketching the background of the Proteus icing troubles, the Ministry said the engine successfully passed normal icing tests applied to other engines. The "peculiar susceptibility" of the Proteus to special icing conditions became apparent in the course of BOAC proving flights about 18 months ago, the statement said.

"Dry ice was the difficulty at first and was encountered during early proving flights in Africa," according to the statement. "It was found that flight through high concentrations of dry ice resulted in what are known as flame-outs."

To overcome this particular difficulty and to assist efforts being made by Bristol and BOAC a special committee was set up under Dr. G. W. Gardner, Director of the Royal Aircraft Establishment at Farnborough of representatives of the Air Ministry meteorological office, Ministry of Supply, Ministry of Transport and Civil Aviation, Air Registration Board, BOAC and Bristol. As a result engine modifications were made which considerably alleviated the dry ice difficulty and enabled BOAC to begin passenger operation with Britannia 102 series aircraft in February last. Further operating experience however and in particular experience of monsoon conditions in India and the Far East showed that although the engine as modified could cope satisfactorily with dry ice it could still be affected by certain conditions of ice crystals and water occurring together.

Study Pressed

"The problem posed by this fresh discovery has yet to be fully solved but the Gardner committee is hard at work and a number of promising lines of investigation are being urgently pursued. In the meantime the Ministry is advised that the aircraft can be flown normally provided due regard is paid to the advice in the flight manual.

"With this in mind he has accepted recommendation of Air Registration Board.

". . . The government have made it clear to all concerned that they are most anxious that the problems should be quickly solved so that the full potentialities of the aircraft can be realized."

Subsidy Lines May Retain Sales Profit

By Ford Eastman

Washington—Civil Aeronautics Board is authorized to allow subsidized airlines to retain the profit from the sale of property if it is needed for reinvestment in new equipment, according to Examiner Paul N. Pfeiffer.

In his initial decision in the Capital Gains Proceeding, Pfeiffer concluded that CAB has the power to permit retention of such gains for reinvestment in new equipment rather than considering the amount as other revenue to reduce subsidy payments to the carrier. He said, however, the carriers have not demonstrated a need permanently to retain retirement gains.

Equipment Financing

His conclusion would permit carriers that might have difficulty in securing financing for new equipment to temporarily use the profits for this purpose, but eventually the money would be recaptured by the CAB to offset subsidy. Subsidy free carriers would not be affected.

Pfeiffer's conclusions are in contrast with an earlier contention by CAB bureau counsel that the Board has no authority to permit airlines to retain capital gains.

The 29 airlines that were parties to the proceedings were given until Oct. 10 to file exceptions. Oral arguments and a final opinion by the Board are expected before Congress reconvenes to consider legislation dealing with the same matter.

The Capital Gains Bill, which already has passed the House, is scheduled to be considered by the Senate during the next session. The bill would permit all subsidized airlines to set aside profits from the sale of property for reinvestment in new equipment. This money would not be considered other revenue in determining a carrier's subsidy requirements, and the carrier would be permitted to retain the profits permanently.

Airlines would prefer passage of the Capital Gains Bill since it would give all subsidized carriers permanent retention of profits. The examiner's decision would, in effect, defer using the profits as an offset against subsidy providing the carriers demonstrated a need in order to reequip. A final decision by the Board similar to the examiner's stand might have considerable effect upon passage of the bill, airlines believe, since it says the CAB already has the power to do substantially what the bill is designed to do.

Case of Retention

In the case before the CAB, airlines contended that retention of capital gains is necessary to meet their reequipment programs, required for reduction of subsidy, competitive necessity, defense needs and international considerations as well as for improved public service.

The airlines say approximately $620 million in new flight equipment and

$86 million in additional working capital will be required by the subsidized industry for the period 1956 to 1960. Against this figure, $90 million is available from depreciation, $54 million from net earnings, $67 million in net capital gains and $15 million in recovered residual values of aircraft. This results in a balance needed from debt or new equity sources of $480 million. If capital gains are captured, this amount would increase to $547 million.

Sale Damper

They said further that confiscation of capital gains would render the sale of equity capital virtually impossible in most cases because of the spotty earnings and dividends record which has shown an average net profit of 3.5% since 1945. Of the 29 airlines in the case, only 11 have paid dividends and, of these, the majority have paid dividends either for one or two year periods or only to preferred stockholders. Moreover, the airlines said, there appears to be little prospect of appreciation in common stock values.

The airlines pointed out that if $10,000 had been invested in the Braniff, Continental and Pan American common stock in 1945 it would be worth only $8,810 in 1956. On the other hand, they contend, if a corresponding amount had been placed in the Dow Jones industrial average, it would have advanced to $54,030 by 1956.

With respect to borrowing capability, the carriers cited the existence of a tight money market resulting in high interest rates and a reluctance by lenders to extend credit to the subsidized airline industry in view of its relatively high debt-equity ratio.

Airlines said it has been the assumption of aircraft manufacturers and airline investors alike that capital gains would supply an important proportion of the capital required for modernization and expansion of air carrier fleets.

Ability to Purchase

To evaluate the effect of capital gains capture or retention upon the carriers' ability to carry out proposed re-equipment programs, Pfeiffer traced replacement of a single aircraft through the stages of original acquisition, depreciation, replacement, depreciation and return on investment of the new airplane using Pacific Northern Airlines as an example.

In August, 1947, he said, Pacific Northern purchased a DC-4 for $138,338, modified it for $196,521 to bring the total cost to $334,859. As of Sept. 30, 1956, the book value of the airplane had been written down through allowances for depreciation to $77,907. Pacific Northern said the plane at present has an estimated market value of $550,000. Thus, there would be a gross capital gain of $472,000 or a net capital gain after taxes of $354,000. The replacement of the DC-4 by a Lockheed Electra would cost $2,350,000.

Normally, insurance companies and commercial banks will lend up to 75% of the value of the equipment to be purchased, Pfeiffer said. On this basis, Pacific Northern would have to deposit $587,500 in cash to consummate the purchase. If Pacific Northern were deprived of its $354,000 net capital gain for use as a down payment, it would have to rely upon the book value of the DC-4 airplane at $77,907 and contribute the balance from earnings and/or from capital contributed by existing or prospective stockholders.

Pacific Northern said that the procurement of equity capital would be impossible since its earnings have averaged only $60,000 a year, no dividends have been paid, and its stock is selling at less than its 1953 price.

Guaranteed Loan Aid

Pfeiffer added, however, that Pacific Northern's predicament could be alleviated through the Government Guaranteed Loan Bill, passed by the last session of Congress. Under the bill, the government would guarantee 90% of loans on new equipment up to $5 million. Pacific Northern would have to deposit only 10% of the cost of the airplane as a down payment.

Assuming that the banks or insurance companies are willing to make loans on this basis, such a guarantee would reduce the necessary down payment on the Electra to $235,000, or a cash deficit of $157,000–$235,000 less $77,907 residual value of the sold DC-4.

Pfeiffer said raising that much cash might not be an insurmountable task for airlines the size of Pan American, Panagra or Braniff but that it might prove to be unobtainable in the case of smaller airlines such as PNA and local service carriers. They would have to resort to additional debt capital in order to obtain the necessary cash.

Airlines already possessing a heavy debt structure and having difficulty in raising equity capital may suffer a hardship through recapture of capital gains, he said.

Temporary Use

"Therefore," Pfeiffer added, "it would appear that, despite the existence of federal loan guarantee legislation, the capital structure of the industry would be better protected if the carriers were allowed at least the temporary use of the capital gains for purposes of enlarging down payments on the purchase of new equipment."

However, if Pacific Northern were permitted to permanently retain capital gains, Pfeiffer said, and add its net capital gain of $354,000 to its $77,907 DC-4 residual value and obtain the remaining $155,500 in cash necessary to meet the down payment on the Electra, the airline would increase its return on investment from $7,791 to $235,000 in the first year.

The Electra would go on its books for depreciation purposes at full cost, including the reinvested capital gain on the sold DC-4 and, at the end of seven years, PNA would have recovered $2,350,000 less 15% residual value, a sum almost sufficient to pay off its $1,762,500 loan plus interest without dipping into the augmented return.

Considering the increased depreciation allowance plus the return on the larger investment, Pfeiffer said the carrier's assets and income would be substantially increased from the replacement transaction, assuming that return and depreciation allowance were not siphoned off through disallowances of expenses not considered the result of honest, economical and efficient management.

On the other hand, he said, the government would be paying a 10% return on the $354,000 re-invested capital gain included in the investment base and in addition recognizing as a proper element of cost the same amount of capital gain in the depreciation account.

'Less Capital Gain'

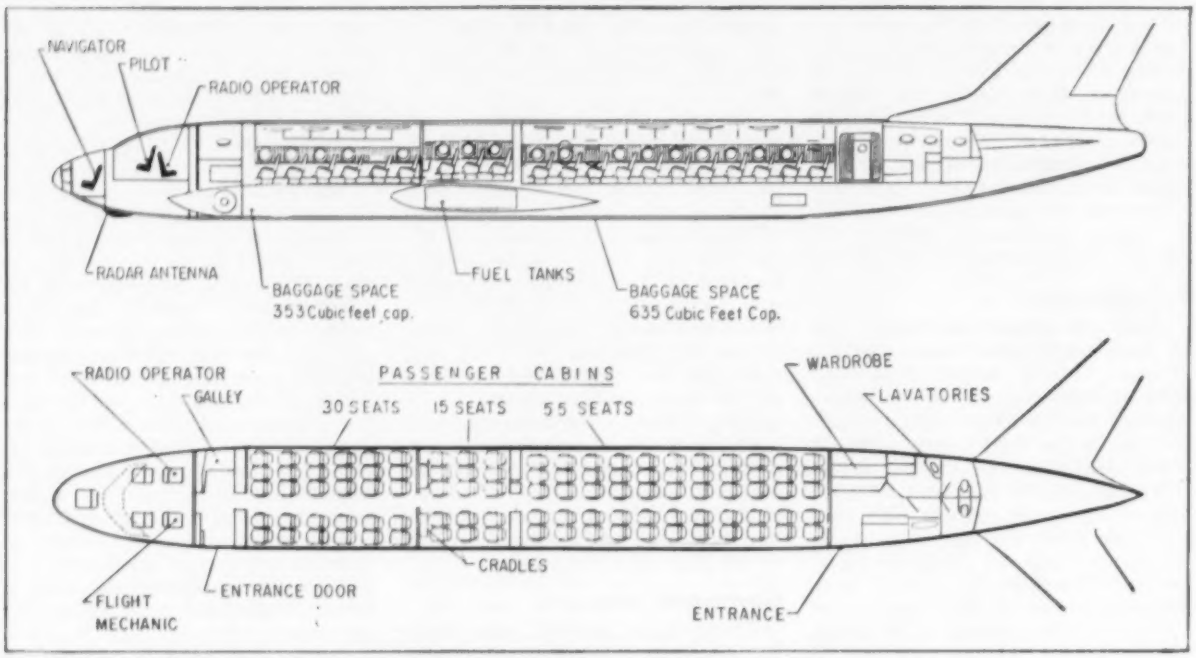
He added, that, if the Electra were carried on Pacific Northern's books for investment purposes at "less capital gain" ($1,996,000), the carrier still would receive a return of $199,600 the first year in lieu of its present $7,791 on the retired DC-4.

Moreover, since the Electra would presumably generate a depreciation allowance less $354,000 capital gain and residual value of $1,644,500, at 15%, PNA would have sufficient funds to pay off its $1,762,500 loan plus 5% interest–bearing in mind the increased net operating revenue to be expected from the operation of the turboprop equipment.

"Therefore," Pfeiffer said, "while the average subsidized carrier may have a temporary need to use capital gains in connection with the down payment on the purchase of new equipment, it does not have a genuine need for permanent retention of such capital gains.

"In other words, the carrier does not have a requirement that the government recognize the reinvested capital gain in the new airplane's depreciation account in order to carry out its program of reequipment.

"Also the carrier does not require that the government pay a return on the reinvested capital gain–a profit on a profit–in order to accomplish the same purpose."



TU-110 has high density seating arrangements and improved galley compared to the Tu-104.

More Thrust Improves Russia's Tu-110

Moscow—Design details of Russia's new four jet transport, the Tu-110, have been revealed by the aircraft's only prospective operator, Aeroflot. The state-owned airline reports that the aircraft was designed, built and flown within an 18 month period.

The new transport has the same general appearance as the older, twin-engined Tu-104, but has approximately eight feet more wing span and a four foot longer fuselage. The most important improvements in the Tu-110 according to Aeroflot are better economy, greater range, and improved operational reliability—all achieved through increased power.

Thrust Increase

Power for the Tu-110 is provided by four turbojets designed by A. M. Lulko and similar to his engines in the Tu-104 and Tu-104A. The air ducts are slightly larger on the Tu-110, probably indicating an increased thrust rating.

Doubling the thrust on virtually the same basic airframe has raised the allowable takeoff weight considerably. The new plane carries 100 passengers as compared to 50 for the original version of the Tu-104. The Tu-110 can carry payloads up to 26,455 lb. which are broken down into: 100 passengers, (16,500-17,600 lb.), plus 3,520-4,400 lb. of baggage and 4,400-6,380 lb. of cargo or mail.

Power reserve is sufficient to allow three-engine takeoffs and a rate of climb of 984-1,182 ft./min. with gear and flaps down and one engine out.

Primary structural difference between the twin-engined Tu-104 and Tu-104A and the four jet Tu-110 is the manner of supporting the engines. On the Tu-110, the powerplants are tied to the spar and wing ribs of the center wing section. Engines of the Tu-104 and Tu-104A are attached to aircraft's fuselage frames at the wing roots.

Carrying the engine loads on the wing has allowed a lighter and more simple fuselage construction. Eliminating direct structural contact between the engines and the fuselage has lowered the noise level in the passenger compartments.

Spar Loads

Heavy structure necessary to carry wing spar loads around the engines is said to consist of built-up stampings on all three of the Tupelov turboject transports. This is a departure from normal U.S. practice of using large forgings.

To improve the Tu-110's landing and takeoff characteristics with its higher wing loading, the flap chord was increased in general and additional flaps were added under the engine nacelles.

Passenger section of the fuselage is divided into three cabins. The first of these is situated between Rib No. 15 and the forward spar of the wing center panel. It accommodates 30 persons in six rows of seats; each row seats two on one side of the aisle and three on the other. Each seat has a separate back which tilts 40 deg. In one block the arms between the seats can be removed.

The second or center cabin seats 15 persons and is located over the center wing panel.

Behind this there is the third passenger cabin for 55 passengers. There

Tu-110 Performance

Following estimates of Tu-110 performance and relative operating costs were made by the Tupelov Design Bureau using methods prescribed by Aeroflot's Scientific-Research Institute:

Maximum speed.....621 mph.
Range (with 26,455 lb. payload).....1,925-2,050 mi. (includes one hour fuel reserve)
Maximum cruise speed.....497 mph.
Cruise altitude.....32,800-39,360 ft.

Estimated ton-mile costs with the 26,455 lb. payload approach those of turboprop transport.

From the standpoint of ton-mile costs the Tu-110, Tu-104A and the Tu-104 can be used on stage lengths varying from 621 mi. to the maximum range of the aircraft in the opinion of Aeroflot. Cruise speeds rise on the shorter routes to a maximum of 559 mph. and the utilization efficiency is increased.

TU-110 is new four engine version of the older twin-jet Tu-104 which has been in scheduled airline service around one year. Aircraft has entered the flight test stage.

are 11 rows of seats with the same arrangement as the forward cabin.

Galley arrangements on the Tu-110 represent an improvement over the facilities of the Tu-104 and Tu-104A. On the older aircraft the galley was in the center section and heavy food containers had to be carried aboard through the rear passenger compartment. The Tu-110 galley is located just behind the crew compartment. Loading of food is done directly through a forward door.

There are 24 standard containers in the galley. The first courses of meals served to passengers are kept in seven thermos jugs each holding about 8.5 quarts. The second courses are kept in eight containers. A boiler and coffee maker each of 21 quart capacity are provided for preparing coffee and tea. There are 112 serving trays in 14 containers. The chef takes a tray from the containers, pours hot broth, tea, coffee, or fruit juice into a cup and puts the heated second course on a plate.

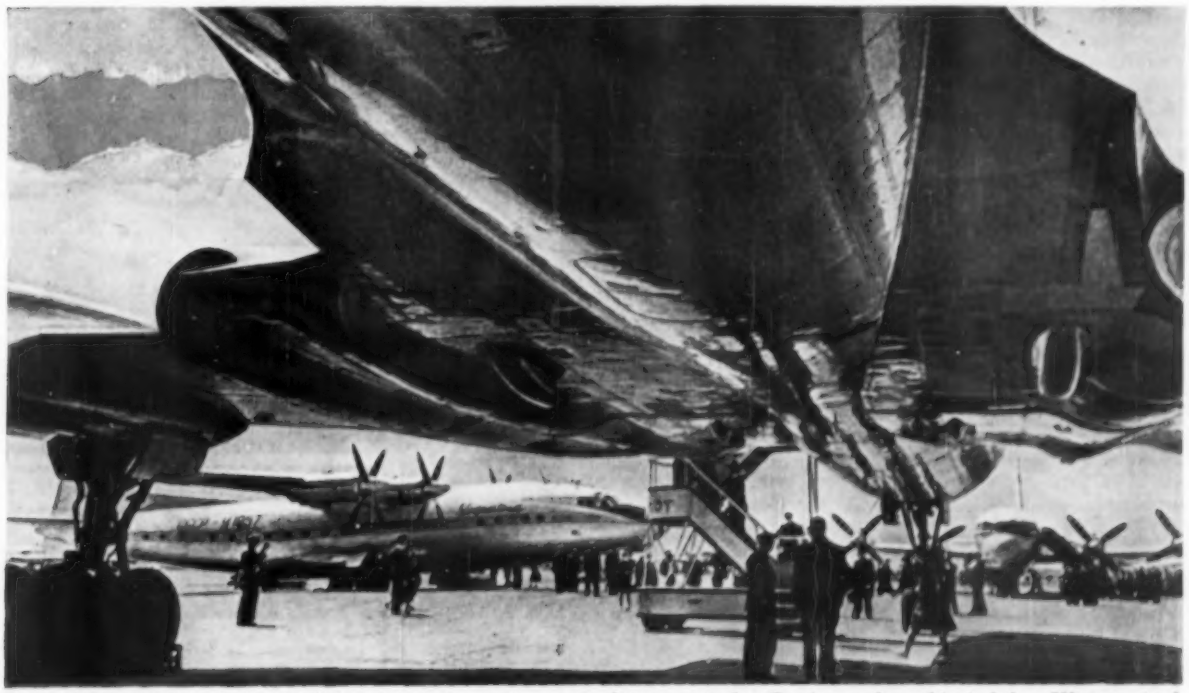
The crew cabin is separated from the galley and the passenger areas by an airtight bulkhead which is installed on Rib No. 11, which divides the aircraft into two pressurized areas.

Two wardrobes, two lavatories, and a vestibule are located behind the rear passenger area. The sanitary unit is a new and improved design. A 66 gal. tank containing water and a special liquid chemical serves the stools in both lavatories. Water for the two wash stands comes from a single 21 gal. tank. The wash stands drain into the same tank that serves the stools.

Below the drain tank is a neck with a double, air-tight cap. In draining the liquid, one part of the cap is opened, connection is made with a ground cistern and then the second part is opened.

Aeroflot says that the new type sanitary unit has eliminated the possibility of overflow of the individual stools, reduced the amount of piping necessary and simplified the replenishment of the water supply and draining of waste liquid when the plane arrives at the airport.

Baggage compartments in the Tu-110 are larger than those of the



THIS PHOTOGRAPH of the Tu-110 center wing section contradicts reports that Russian workmanship is below Western standards. This type of engine installation with its fairings and compound curves is one of the most difficult aircraft construction problems. Its cleanness is usually a good indication of manufacturing skill.

A full-time money-maker... the new

DOUBLE-DECK JET-PROP VANGUARD

The new Vickers Vanguard is the most flexible airliner ever designed. Though primarily a de luxe passenger plane, it can, during off-peak periods, operate profitably solely as a freighter!

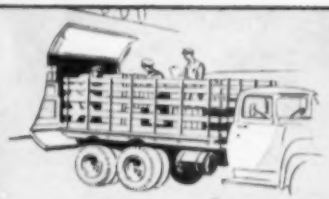
2-in-1 aircraft!

The Vanguard's elegant upper deck passenger cabin has all the Viscount's popular comfort advantages: king-size panoramic windows . . . wide, fully-reclining seats . . . and, of course, that well-known jet-prop smoothness.

The Vanguard's two lower deck cargo holds can carry 10 tons of payload, and no alteration in the upper deck is required to do it!

Powered by four Rolls-Royce Tyne jet-prop engines, the Vanguard will be capable of speeds up to 425 mph over a 2500-mile range with full payload. Into each Vanguard will be built over 2 million flying hours of Vickers jet-prop experience. And there's no substitute for experience.

76, 86, 93, 120 passengers! The upper deck passenger cabin has great layout flexibility . . . can easily be adapted to all first-class, various mixed-class combinations, or all tourist-class. There are two passenger doors, each with built-in folding stairs.



10 tons of freight! The Vanguard's lower deck holds have a capacity of nearly 1400 cu. ft. . . . can carry the plane's full payload. With two 5' 6" wide doors, freight can be simultaneously loaded and unloaded quickly, easily.

jet-prop **VICKERS VANGUARD**

POWERED BY FOUR ROLLS ROYCE-TYNE ENGINES

U. S. Representative: Christopher Clarkson
10 Rockefeller Plaza, New York 20, N. Y.

VICKERS-ARMSTRONGS (AIRCRAFT) LTD., WEYBRIDGE, ENGLAND • MEMBER OF THE VICKERS GROUP

Tu-104. This was accomplished by raising the floor on the passenger compartments 5.5 in., while lowering the floor of the baggage area 2.8 inches. Overall volume of the baggage compartments located beneath the floor of the forward and aft passenger cabins is 988 cu. ft. Baggage is loaded into these through two side hatches.

U. S. Lines Supported By Varig in Bilateral

Washington—Varig Airlines, one of Brazil's leading air carriers, is siding with American flag carriers in their request for a less restrictive air transport agreement between the U.S. and Brazil. Bilateral discussions between the two countries are now under way here.

Ruben M. Berta, Varig director-president, says his airline would prefer to compete with U.S. airlines on an equal basis and therefore favors removal of restrictions against U.S. carriers. He adds that his airline has undertaken a large re-equipment program and believes he can compete with American flag carriers for traffic between the two countries on the basis of service.

The Brazilian government, U.S. airlines claim, restricts capacity and imposes other restrictions such as limiting stopover privileges, higher gas tax and safety regulations which are unrealistic and forces circuitous routings.

These are on the agenda for discussion during the current negotiations. Other items to be discussed between the two countries include Fifth Freedom traffic, lower fares between the U.S. and Brazil which are charged by another Brazilian airline, REAL. REAL is not a member of the International Air Transport Assn. and the exchange of routes.

Brazil now has three routes to the U.S. Varig flies to New York, while REAL flies from Brazil to Miami and Chicago. The third route, from Brazil to New Orleans, has never been used.

REAL hopes to extend its route from Miami to New York, a move which Varig will oppose along with U.S. airlines. Varig, on the other hand, wants a route from Brazil to San Francisco or Los Angeles via Mexico City and on to Tokyo.

With Varig and U.S. airlines adopting similar stands on several matters to be discussed, U.S. airline spokesman privately indicated a Brazil-U.S. West Coast route for Varig is a possibility, although serious opposition might develop in naming Mexico City as an intermediate point.

Willingness on the part of Brazil to forego authorization of its Brazil-New Orleans route could add weight to the exchange of such a route to the West Coast, according to the spokesman.

Air Transport Assn. Challenges CAB's Airspace Control Plan

Washington—Civil Aeronautics Board's plan for control of all airspace at high altitudes beginning Nov. 1 drew sharp protests last week from the airline industry.

Although the scheduled domestic carriers support the control of all airspace in principle, the airlines are objecting vigorously to certain features of the control plan and are charging that, while it meets military requirements, airline needs have been neglected. Between now and Nov. 1, the airlines will wage an intensive campaign against the plan through the Air Transport Assn. in hopes of getting a system concept more to their liking.

The present plan is a CAB amendment to Civil Air Regulations and will be implemented by Civil Aeronautics Administration. It is known as an interim plan for control of all airspace at high altitudes and is scheduled to be introduced in two steps. First phase, to be inaugurated Nov. 1, will establish all airspace above 24,000 ft. as a continental control area. Later, phase 2 will bring a lowering of the control floor to 15,000 ft.

Features of Plan

Here are the three chief features of the plan the airlines are protesting:

- **High altitude** routes above 27,000 ft. to be known as jet routes will be established. Purpose is to delineate a high-altitude route system. Airlines claim that such routes fulfill military needs but fail to serve civil requirements. Airlines want the Victor 1500 airways (high altitude) structure to extend from 15,000 ft. to above 40,000.
- **For instrument** flight rules flight above 27,000 ft., navigation will be conducted under the CAA plan on designated high altitude VOR, Tacan, Vortac or L/MF facilities. The L/MF facilities presumably are retained as a concession to certain units of the Air Force which are not equipped with VOR or Vortac. However, because of the lack of precision in L/MF navigation, the airlines want the high altitude route structure to be based primarily on VOR or Vortac. They are willing to accept L/MF in the continental control area on a temporary basis only.
- **Under the plan,** colored and Victor airway systems will form a route structure within the continental control area from 24,000 ft. to 27,000 ft. but not including 27,000 ft. Airlines want these routes held outside the continental control area or extended to, but not into, the high altitude controlled airspace.

The CAA expects to incorporate the Victor 1500 airways system into the plan at an early date in compliance with wishes of the airlines. It is also expected that the CAA and CAB will take the necessary steps to establish a 15,000 ft. floor level for the Victor 1500 airways and expand the series to create the additional north-south and east-west routes the airlines seek.

However, the CAA is not likely to accept a delay in the implementation of the plan in order to allow more time for discussion on the other two controversial issues. CAA has every intention of meeting its target date despite possible equipment problems, airways charting and the revision of procedures.

The high altitude plan will be published in the Airman's Guide and by NOTAM. Charts showing the designated high-altitude aids are being prepared by the USAF Aeronautical Chart and Information Center.

Essentially, the plan calls for no change in VFR operations, and such flights will be conducted in the continental control area as they are now flown in any controlled airspace. Similarly, flight rules currently governing VFR conditions-on-top will apply in the continental control area regardless of altitude.

Since all airspace at high altitudes will be designated as control area, aircraft will not be required to adhere to route structures in order to receive air traffic control service. However, such aircraft will be required to fly on routes defined by high-altitude navigation aids where they can receive air traffic control coverage provided the aids are not more than 300 nautical miles apart.

Compulsory Reporting

Compulsory reporting points have been established under the plan. Initially, all designated high-altitude navigation aids will constitute reporting points and additional points will be established at critical intersections of airways.

Navigation aids not used for the high-altitude route structure may be used for entrance to and departure from airports not served by the high altitude system.

Flights operating below 27,000 ft. altitude but within the continental control area or above 24,000 ft. which do not follow the colored or Victor airway patterns must define the route of flight according to navigation aids which are no more than 200 nautical miles apart. Aids selected to define the route of flight will be established as compulsory reporting points under the plan.

Airlines Must Promote Jet Travel Before Flights Operate, SAS Says

New York—Three hundred Scandinavian Airlines Systems sales personnel from North and South American points were brought here last week for a briefing on their jet age jobs.

The salesmen are facing the most critical and demanding period in their careers in gearing to the explosive growth of air traffic the jets will require, top officials of the airline warned them.

Need to find and accommodate a true mass market to fill the new fleets was a major theme at the two-day session, according to Warren E. Kraemer, SAS vice president-traffic and sales.

Transition Years

If airline thinking and techniques are not drastically revised during the "bridge years" between jet orders and deliveries, the results will be "woefully inadequate" to keep most airlines in business, Kraemer told AVIATION WEEK.

Carriers on the North Atlantic "have been so swollen with the sense of our own importance that we think we're in big business," Kraemer said.

"Well, we're not. We won't be until we've made it easy financially, servicewise, and every way for Mr. John Doe to travel en masse."

The SAS salesmen were urged to promote jet travel as an entirely new kind of flying and to cash in on the mass public enthusiasm the airline believes will be found.

To this end, SAS sales people at every level in the cities visited by the Caravelle during its American tour were given a ride on the twin-jet airliner. The airline has ordered six, and optioned 19, of the French jets.

Scandinavian Airlines therefore has more sales people with actual jet experience than any other airline, Kraemer believes.

Their own response has been completely enthusiastic, and should be a big boost in promoting jet travel with the public, according to the SAS official.

Caravelle Visits

In Europe several cities served by the airline have been visited by the French jet and all major points on the carrier's system are expected to be covered by the end of 1958.

Scandinavian Airlines has something of an immediate sales problem on its hands with its California-Europe polar route, pioneered by the airline in 1954 and now about to face stiff competition from Pan American and TWA. The foreign carrier recently applied to CAB to add San Francisco as a co-terminal with Los Angeles.

"We won't take anything for granted," Kraemer said of the polar route competition. He feels, however, that SAS has built a reputation on the route and that it will be up to the other airlines to prove they can match the Scandinavian carrier's service.

The American carriers, who had expressed no interest in the polar route until SAS began flying it successfully, have given SAS "the sincerest form of flattery" by imitation, Kraemer said.

Some of his airline's seven DC-8s will be destined for early service on the polar run, Kraemer said. Thus jet flights on the route will connect with domestic jet flights.

Polar Appeal

Big sales appeal of the polar route is its glamor, Kraemer claims, and this attraction is not expected to dim with increased polar traffic. People vicariously enjoy the spirit of polar adventure, according to Kraemer, and furthermore the route is fashionable.

"In Europe, you're declassee if you don't arrive by the polar route," he said.

Scandinavian Airlines has a jet age sales lead in the Caravelle, Kraemer points out. Transatlantic DC-8 flights will connect with Caravelles on European segments, thus providing all-jet routing.

Interiors of both Caravelles and DC-8s will break away from the "railway coach" philosophy of the past, Kraemer said. New concepts in inflight comforts and services as well as configurations will be part of SAS's jet age effort, Kraemer said. They will be keyed to this new type of flying.

Major promotional efforts in the package tour area will be made by SAS, according to the official.

An SAS goal, he said, is a 23-day European priced tour under $500.

The airline will push its plan-a-trip tour, a do-it-yourself package in which the customer makes up his own itinerary.

Scandinavian airlines' one-year-old tourist service department in New York can put such tours together in 24 hours now with the help of automatic data processing, Kraemer said, whereas three weeks formerly were required.

The new department grossed $1 million during its first year, is expected to take in $5 million during its second.

Kraemer sees the plan-it tour program as aimed toward packaging the world's cities like supermarket items. Customers can select the merchandise they want and get it at lowest prices.

Scandinavian Airlines' salesmen were told at their meeting that the "quantum jump" in traffic volume upon which the jet age will depend will put additional pressure toward "de-individualizing" the passenger. This trend away from personalized service at ticket counter, baggage counter and inflight must be overcome despite increased traffic, Kraemer said, because such service is one of air transportation's main selling points.

Rep. Harris Challenges Report by Celler Group

Washington—Report by the House Antitrust Subcommittee charging insufficient competition in air transportation has been challenged as "one sided" and "a great disservice" to the industry by Rep. Oren Harris (D.-Ark.), chairman of the House Commerce Committee.

The antitrust group headed by Rep. Emanuel Celler (D.-N.Y.) has urged the Justice Department to investigate the Air Transport Assn. for possible monopolistic practices and the Civil Aeronautics Board to make "a general investigation into all of Pan American World Airways' activities (AW Sept. 2, p. 41)."

The subcommittee also recommended that the policy of the 1938 Civil Aeronautics Administration Act be changed from "competition to the extent necessary" to "competition to the maximum extent practicable."

Harris objected that the Celler report failed to recognize that competition is only one of several public interest factors the CAB must weigh in its decisions.

"The report," he said, "implies that absence of competition, consummation of mergers, establishment of uniform standards under CAB approved machinery and other cooperative working arrangements among airlines must be condemned per se.

"This represents a superficial concern with only one criterion of public interest. . . ."

Harris defended the 1938 act as "adequately covering" the requirements for competition and proof that Congress intended consideration also of other economic factors.

Harris said there is "a basic one-sideness reflected throughout the entire (Celler) report." In the case of Pan American, he objected, it "accepted as fact a variety of accusations made in years past against PAA by its competitors," failed to give consideration to PAA testimony, or give the airline "the judicious treatment . . . that it or any other responsible business enterprise or private citizen should receive."

Iberia Fills Piston Needs, Looks to Jets

By L. L. Doty

Madrid—Iberia Air Lines of Spain has completed its piston-engine re-equipment program and will withhold any further expansion of routes until it moves into the turboject field.

The airline has reached a firm decision to add turbojet transports to its present fleet as a necessary step in retaining its competitive stand in the North Atlantic market, but it has not yet settled on the make of aircraft best suited to its needs. Most likely prospect is Boeing's 707 (AW July 29, p. 45).

Meanwhile, the airline has doubled its service between Madrid and New York and added modern equipment to its South American schedules as the result of an improved turn-around maintenance program and the purchase of two Lockheed Constellation 1049Gs earlier this summer.

A total of five 1049Gs, three of which are converted 1049Es, operate on the airline's overseas routes. Five Convair 440s serve the carrier's extensive European and intra-Spain routes. A fleet of 6 DC-4s, 17 DC-3s and 4 Bristol A170s complete Iberia's fleet.

FIFTH and final Lockheed 1049G is delivered to Iberia Airlines. Plane seats 63.

Constellation Maintenance

Constellation maintenance is performed at New York International (Idlewild) Airport under contract with Lockheed Aircraft Service-International (LASI).

The maintenance program, involving maintenance inspections, overhaul services and component replacements, is scheduled to permit turn-around of aircraft within an eight hour period. The sharp time cut in the "equalized maintenance system" from an earlier twenty-four period has enabled the airline to schedule its fleet of five Constellations over four separate transatlantic routes. Here is how the Iberia overseas Constellation schedules will be operated effective October 7:

- **Four weekly flights** between Madrid and New York will be reduced to three weekly because of the seasonal slack in tourist traffic.
- **Once-a-week Constellation** flight will be inaugurated on Oct. 7 from Madrid to Dakar, Rio de Janeiro, Montivideo and Buenos Aires. A second flight to Buenos Aires will be operated with a DC-4 via La Sal and Natal.
- **Weekly flights** to Havana via Bermuda from Madrid and to Caracas from Madrid via Puerto Rico already are scheduled with Constellations.

This high utilization restricts the Constellation fleet to scheduled service only and prohibits the airline from seeking additional revenues through charter service or extra sections.

Engine overhaul time has been set at 1,000 hours and airframe overhaul is performed every 12,000 hours. Iberia maintains a staff of four technicians at the LASI installation, one of whom serves as a permanent base representative for the carrier. The remaining three positions are filled by mechanics from Spain on a rotating basis.

Maintenance on all other aircraft is handled at the company's main base at Barajas Airport in Madrid. Any emergency on-line maintenance is covered by sending teams of mechanics and engineers to the trouble base. However, all engineering and technical personnel at Madrid are Spanish.

The airline is focusing its major traffic development effort on the Madrid-New York market but has no current plans for extending this route. The airline, however, hopes to expand its Madrid-Puerto Rico-Caracas route into Bogota and is awaiting ratification of a bilateral agreement by the Colombian government to authorize this service.

Passenger Expansion

In view of its 41,000 miles of routes including a route from Madrid and Valencia to Bata in Spanish Guinea on the central West African coast, any additional expansion of Iberia's system would put a strain on the operating capacity of the carrier's fleet. However, Iberia is anticipating a substantial increase in traffic on its present routes in 1957 over last year with the seats it now operates.

Indications are that the airline will pass the one-million mark in passengers carried during 1957. This compares with 673,343 handled in 1956. Last year, Iberia had a net profit of approximately $968,000 (U.S.) of which $158,000, or 7% of capital, was distributed in dividends. The balance was withheld in the company as reserve. Although the airline is incorporated, it is state-controlled and owned.

In 1956, the airline operated 26,774 flights and flew 9,910,000 miles. It handled 1,591 tons of freight, 870 tons of air mail and flew 281 million passenger-miles.

The airline has 2,447 employes, 73 pilots and co-pilots and an auxiliary flight crew of 168 members, including radio operators, navigators and stewardesses. Iberia trains its own pilots.

Iberia Air Lines was established by government decree in 1940 after the Spanish Civil War had brought all airline operations to a halt in 1936. World War II prevented full development of the airline, and it was not until 1947 that it opened its transatlantic routes to South America. Service to New York from Madrid began in 1954.

First airline service in Spain was established in 1921 to bring air service between Madrid and Spanish Morocco. Two other airlines were organized in subsequent years but, in 1927, all three carriers were merged into one organization known as Lineas Aereas Postales Espanolas. In 1932, the airline was nationalized by the Spanish government. It operated domestic routes as well as a route to Lisbon with Ford trimotors and Douglas DC-2s until the Spanish Civil War began.

Thomas Delgado is president of the airline and Cesar Gomez Luzia is general manager. Jose M. Sagristo is general manager for the U.S. The airline maintains sales offices in New York, Washington, Philadelphia, San Francisco and Chicago in the U.S. and operates a bonded warehouse near Wall Street in New York for handling international cargo shipments.

The exciting 500 mph Caravelle—the only twin turbojet airliner flying in the free world today.

THE ONLY OIL APPROVED FOR THE WORLD'S MOST ADVANCED TURBINE AIRLINERS!

ESSO AVIATION TURBO OIL 35

Anticipating by many years the need for an entirely new synthetic lubricant, Esso researchers, working in close association with the British Ministry of Supply and engine designers and builders, produced Esso Aviation Turbo Oil 35—a synthetic oil that met and exceeded the stringent lubrication requirements of turboprop and turbojet engines.

The development of this product is a typical example of Esso's continuing leadership in turbojet lubrication.

ESSO AVIATION TURBO OIL 35—the one engine oil for these modern aircraft of today and tomorrow:

	POWERED BY
Vickers Viscount	Rolls-Royce Dart
Sud-Aviation Caravelle	Rolls-Royce Avon
Bristol Britannia 300 Series	Bristol Proteus 755
Fokker/Fairchild F-27	Rolls-Royce Dart
DeHavilland Comet IV	Rolls-Royce Avon
Boeing 707*	Rolls-Royce Conway
Douglas DC-8*	Rolls-Royce Conway

8 OUT OF EVERY 10 OF THE WORLD'S INTERNATIONAL AIRLINES USE

ESSO

AVIATION PRODUCTS

***Esso Aviation Turbo Oil 15, a lighter viscosity grade, is recommended by Pratt & Whitney Aircraft for the JT-3 and JT-4 engine models which have been selected by many airlines to power their 707 and DC-8 aircraft.**

SHORTLINES

▶ **Sabena Belgian World Airlines** will add three new stopping points to its existing network with the introduction of the airline's winter schedules on Oct. 6. Montreal will become a twice weekly stopping place on the Brussels-New York line; Istanbul will be serviced once a week from Brussels via Frankfurt and Athens, and Belgrade will be serviced twice weekly direct from Brussels. Transatlantic services to New York from Brussels will be reduced from 11 to nine flights a week.

▶ **Piedmont Airlines** flew 44,646 passengers 8,604,422 revenue passenger-miles in August for a new company record. The passenger load factor for August was 61.54 as compared with 52.93 in 1956. During the first eight months of 1957, Piedmont carried 289,866 passengers for a 7.44% gain over the same period of last year.

▶ **United Air Lines** claims a world record in revenue passenger-miles in one month by flying 518,500,000 revenue passenger-miles during August. The figure represents a 15% gain over the same month last year. In recording the record, United operated its fleet of 185 airliners a total of nearly 1,000 trips daily during August.

▶ **American Airlines** carried 725,000 passengers more than 482 million revenue passenger-miles during August. This was compared with 704,000 passengers and 466,350,000 revenue passenger-miles for August last year. Airfreight for the month was 7,685,000 ton-miles against 7,014,000 during the same period last year.

▶ **Ethiopian Airlines** registered a net profit of $318,000 during 1956 according to a report recently released to stockholders. Operating revenues in 1956 were $4,240,000; operating expenses amounted to $3,913,000. The airline flew 70,615 passengers approximately 33.3 million revenue passenger-miles during the year. Ethiopian Airlines is managed and operated by Trans World Airlines.

▶ **Emery Air Freight** is going after St. Lawrence Seaway construction shipments with a new service especially designed for contractors on the project. The freight forwarder has set up two routes involving direct service to Buffalo for shipments over 200 lb., and to Syracuse for shipments up to that weight. Transfers from these points are made to Massena as the delivery point via specially arranged overnight trucking service, Emery reports.

AIRLINE OBSERVER

▶ Look for a decrease in military travel on commercial airlines due to cutbacks in defense spending. A downward trend already has been noticed, but the full impact of reduced spending will not be felt until early next year. Defense Department transportation section says travel has not been greatly reduced as yet but adds it is logical to expect a cut. However, at least two major airlines have experienced a sharp drop in military travel during the past 30 days. Joint Airlines Military Ticket Offices (JAMTO) at 63 military bases report that military travel normally averaged $3.5 million monthly before the decline.

▶ **International Air Transport Assn. traffic conference opened last week with the problems of introducing the proposed third class fare on North Atlantic routes in April as the major issue. Although most carriers are unenthusiastic over the prospects of any further rate cut, the majority of IATA members are now accepting the proposed low fares as an inevitable fact. Chief problems to be resolved at the Miami conference in adopting the third-class rates concern seating density and the quality and quantity of in-flight service that will be provided economy-minded passengers.**

▶ Supplemental airlines have virtually dropped their service for individually ticketed passengers on flights between New York, Washington, Chicago and the West Coast and Florida. The "regular" irregular service was once an active phase of airport operations in New York, Chicago and Washington—particularly when the now defunct Trans American Airlines was at its zenith—but has disappeared entirely from the Washington airport scene. In New York and Chicago, non-scheduled flights are rapidly declining to an inconsequential figure. About 90% of supplemental airline activity is now confined to military commercial air movements and other charter flight operations.

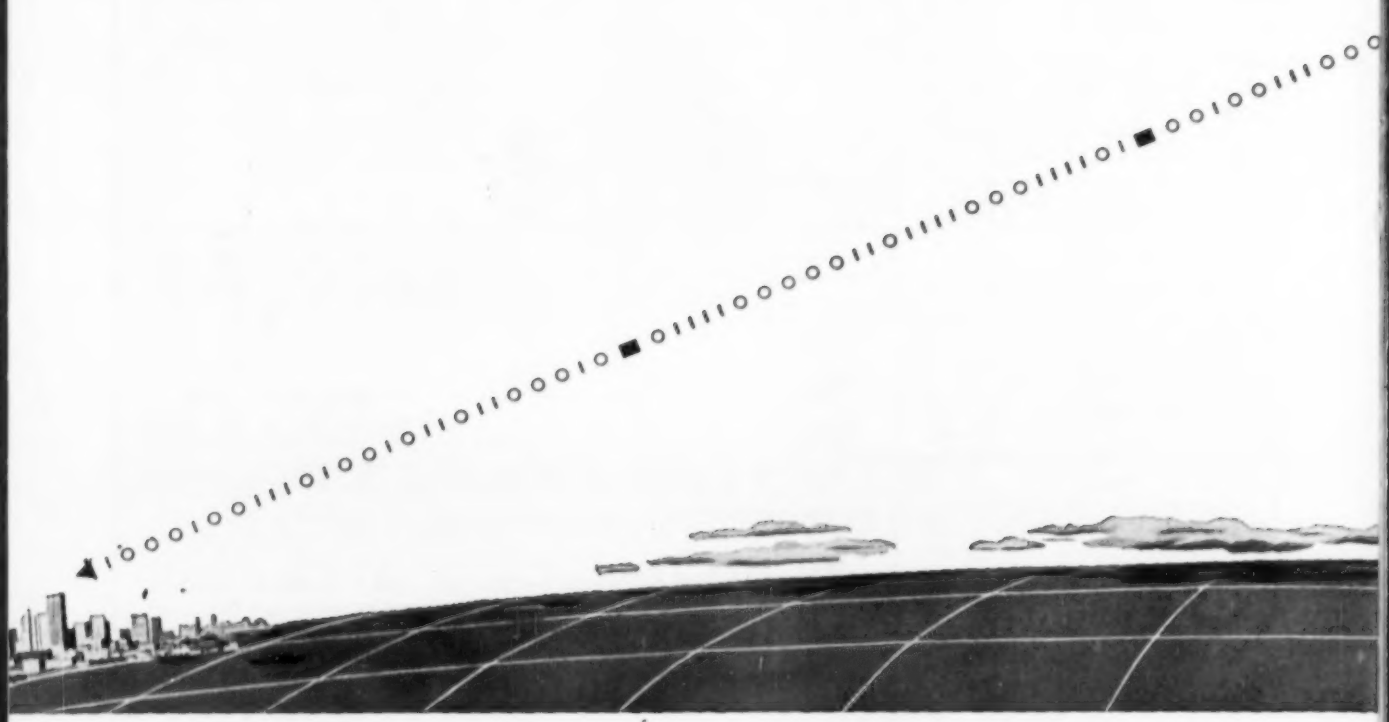
▶ **Fokker will send a Friendship F-27 turboprop transport to Brazil later this year for demonstration flights as part of its overall sales campaign. Fairchild is also conducting an intensive sales campaign in South America. Under its sales and manufacturing contract with the Dutch firm, Fairchild is free to sell the F-27 in every North and South American country except Brazil.**

▶ Capital Airlines has appointed the New York advertising agency of Kenyon and Eckhardt to handle its account beginning October 1. The airline switched its business from Lewis Edwin Ryan of Washington after more than 10 years of association with the Washington firm because it wanted an agency with branch offices throughout the Capital system. Capital's annual advertising budget will be approximately $3 million in 1958.

▶ **San Francisco's Public Utilities Commission has awarded a $17,500 contract to the aviation consulting firm of Leigh Fisher for advice on how to spend the $25 million airport bond issue approved by voters last December. The South Bend, Ind., firm will take about a year to work out recommendations for construction priorities in enlarging and improving the San Francisco Airport.**

▶ Proposal for an overhaul base to handle Rolls-Royce Dart turboprop engines under a pooling arrangement between four West Coast purchasers of the Friendship F-27 has been delayed pending the results of a survey to be undertaken by an independent consultant. The four airlines—West Coast, Bonanza, Northern Consolidated and Wien Alaska—will form a corporation to operate the base if an agreement on the plan is reached. Carriers do not expect to be in a position to discuss details of the proposal for at least another six months.

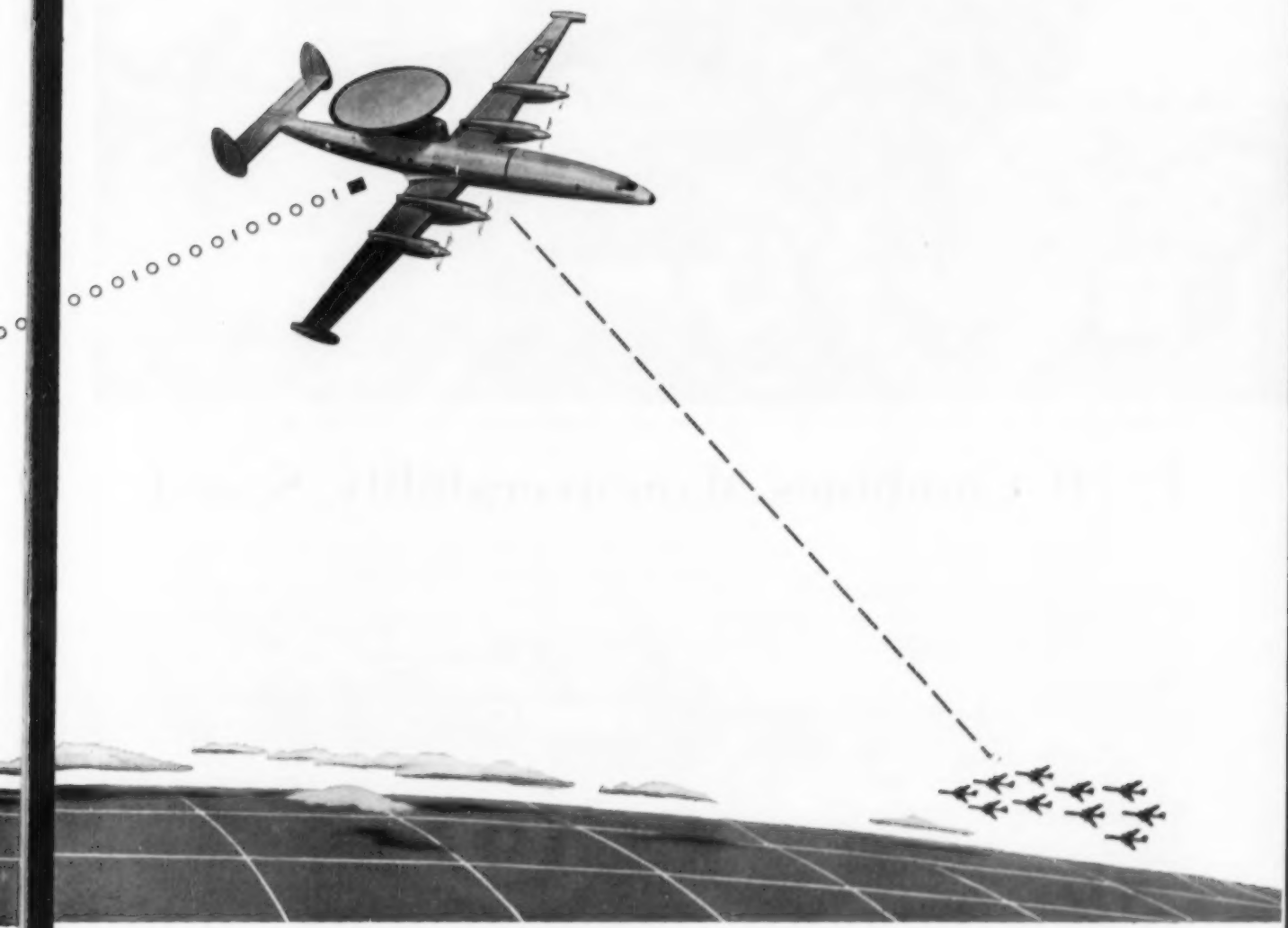
▶ **Delta Air Lines will introduce an expanded cargo program that is scheduled to increase its all-cargo service by 600% with a fleet of five C-46D cargo aircraft purchased from Civil Air Transport Company (CAT). The airline hopes to produce 21 million ton-miles of air freight during the first year of the operation which begins Oct. 1.**



Time... the vital dimension

Ability of the United States to defend itself against attack, and to retaliate against an aggressor, are both vitally dependent on *time*. Every hour, every minute, every second of advance warning time is precious.

Our vast Continental Air Defense system, our powerful Strategic Air Command, our mighty fleets, and world-wide retaliatory striking forces all depend on



Airborne Early Warning (AEW) aircraft to alert them—the moment suspicious planes or ships are sighted approaching our far-flung defense barriers.

Able to "see" 150 miles (in all directions) through dense fog or total darkness, AEW patrol planes have a role so crucial that without them our nation's defense capabilities would be seriously handicapped.

America's safety depends on maintaining our Airborne Early Warning patrols at optimum efficiency and strength

LOCKHEED *means leadership* CALIFORNIA DIVISION, *Lockheed Aircraft Corporation, Burbank, California*

ENGLISH Electric P. 1B, now flying at speeds approaching 1,200 mph., compares favorably with U. S. military designs.

P. 1B Combines Maneuverability, Speed

By David Anderton

Warton, England—English Electric's P. 1B is currently flying at speeds approaching 1,200 mph. underscoring its predominant position as Britain's first truly supersonic military aircraft.

Most impressive of the airplanes demonstrated at Farnborough this year, the P. 1 series has outstanding low-level and high-altitude maneuverability coupled with supersonic flight performance from about 1,000 ft. on up to its ceiling, which is currently limited by powerplant rather than by aerodynamic considerations.

It is the first of the postwar generation of military airplanes designed here that can be compared favorably on overall performance with its contemporaries in the United States.

It was conceived as a research airplane, but evolved rapidly through a proposed day fighter to its present role as a supersonic all-weather interceptor weapon system.

It is now in production here under a slow initial rate of buildup similar to the USAF Cook-Craigie plan. Twenty pre-production aircraft are being built on production tooling to make available a large volume of flight and systems experience before the main stream of production is turned on.

The requirement for the P. 1B visualizes the plane as an integral part of a weapon system with the purpose of long-range interception under all weather conditions. Long range, incidentally, is measured by British standards, not by American or Canadian.

P. 1A prototype takes off for flight demonstration at Farnborough.

External Stores

The airplane serves in this system as the weapons carrier and for that reason can be fitted with a large variety of external stores. One normal armament arrangement is a pair of 30-mm. Aden cannon in the fuselage. The de Havilland Firestreak infrared homing missile was developed for this airplane and although it has not yet been currently matched to it, has been installed and fired from a ground rig simulating the P. 1.

With the power available, the P. 1 can hoist off underwing fuel tanks, rockets, napalm or bombs. It could carry

NOSE SPIKE on P. 1B generates bow shock for supersonic inlet. Circular inlet replaces oval shape on P. 1A.

a bomb underneath the fuselage or a camera pack for photo-reconnaissance.

The fuselage slipper tank which has been flown on the airplane, could be either extra fuel, or a complete Napier Double Scorpion rocket pack to increase thrust by another 4,000 lb. for altitude performance.

Complete airborne radar, working with ground controllers for initial vectoring, is installed in the P. 1B.

Flight Profile

Flight profile is the usual for an interceptor: short takeoff, rapid acceleration and climb to altitude, one or two passes at the target and home again. Endurance is about half an hour, which is probably representative of a typical mission.

The P. 1 series is built around the thrust of a pair of turbojets, mounted so that their tailpipes run parallel in an over-and-under configuration. Engines are staggered fore-and-aft so that the inlet of the upper is almost directly above the tail cone of the lower.

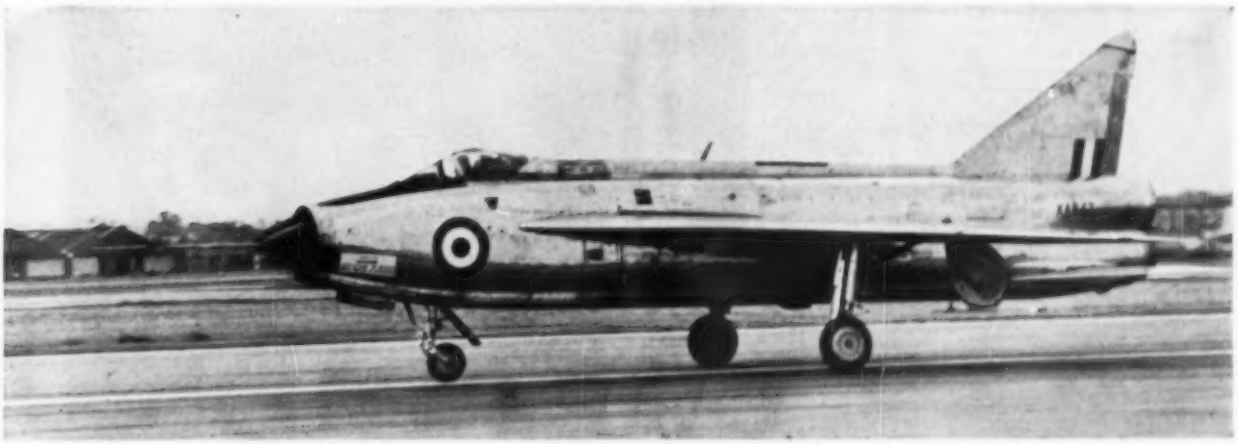
The airframe formula features a highly swept wing set a little above the combined thrust line and a slab tail set well below it. Wing leading edge sweep is 60 deg. The vertical tail is a delta surface.

Wing span of the P. 1 is about 36 ft. and the overall length is about 52 ft.

Aerodynamically the P. 1 is the most sophisticated and the most thoroughly developed configuration yet flown in England.

Calculated first, the basic geometry was developed to its current form by wind tunnel tests in the company's lowspeed and transonic facilities, by rocket-powered model tests, by low-speed evaluation of an aerodynamically similar, full-scale research airplane and finally through flight tests of the prototype P. 1A.

It is a tribute to the engineering of the whole design that there have been no basic layout changes in the series



P. 1B has raised, more conventional canopy than P. 1A. Other changes include spine down back, minor differences in tail and exhaust.

5 basic factors behind the earth satellite launching system

[PROJECT VANGUARD]

NAVAL RESEARCH LABORATORY

GENERAL ELECTRIC

1 **PLANNING**
Project Management
Naval Research Laboratory

2 **PROPULSION**
Rocket Engine (First Stage)
General Electric Co.

3 **PRODUCTION**
Rocket — Satellite Vehicle
The Martin Co.

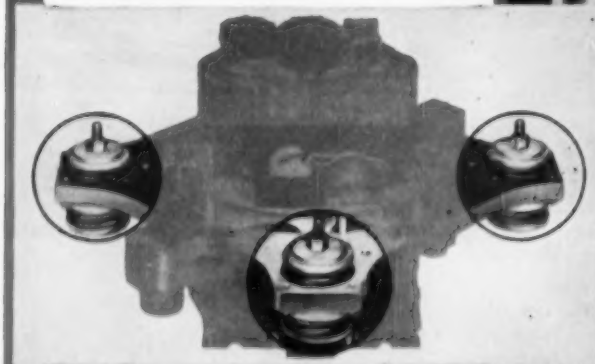
4 **PRECISION**
Guidance Systems
Hermetic Integrating Gyros
Minneapolis-Honeywell Regulator Co.

5 **PROTECTION**
Shock and Vibration Control for Hermetic Integrating Gyros
Robinson Aviation Inc.

MARTIN

MINNEAPOLIS Honeywell

ROBINSON AVIATION Inc.



Complex Honeywell Gyro Reference System supported by Robinson Multi-Directional All-Metal (Met-L-Flex) Mountings (Model 9304-9 shown circled) for the initial test units.

ROBINSON AVIATION · INC · TETERBORO · N·J·

WEST COAST ENGINEERING OFFICE • SANTA MONICA • CALIFORNIA

NOSE wheel doors of P. 1B are smaller than on the P. 1A. Landing gear also is higher.

other than those dictated by the requirements.

Design term of the P. 1 was originally under W. E. W. Petter, who left English Electric by mutual agreement in 1950 to work on the Gnat lightweight fighter concept. The project was taken over by F. W. Page, chief engineer of the aircraft division of English Electric.

Area Distribution

Basic reason for the extreme sweepback of the P. 1 series was the application of the NACA's area rule principle. Wing area of the airplane was determined, as it is on most designs, by the combination of altitude and landing performance compromised with speed consideration. Given a wing area fixed by the specifications, the best way to distribute it along the fuselage is in the smallest increments possible.

In some cases this has been done with a delta surface as in the Convair F-102/106 series. But English Electric engineers decided to use a more conventional wing of slight taper but of extreme sweepback.

Area distribution of this highly swept surface adds a long and easy incremental area to the basic plot of total airplane cross-sections.

With wing sweep and area fixed, tail sides could be calculated. The P. 1 project team, aware of many of the stability and control problems encountered in England and the U. S., ruled out anything but a slab tail, low-set on the fuselage to avoid the pitchup problems frequently encountered with even high-set tails.

Wind Tunnel Tests

The basic aerodynamic configuration of the airplane was developed by extensive wind tunnel tests in English Electric and other British facilities to the final layout that appeared on the P. 1A. The company had been operating a low-speed tunnel for some years previous to the design of the fighter. Early in its design stages, they were able to start operating a transonic tunnel of their own with slotted throat and a test section large enough to do the multitude of model work needed in the aerodynamic verification of the design.

There was another set of input data available to English Electric from the flight testing of a research aircraft, the Short SB. 5. This airplane, contracted for by the Ministry of Supply, was intended to give low speed data, particularly handling characteristics, of the odd layout. The short design was built to take a series of wings of different sweepback and had both lowset and high tee-tail surfaces, plus a variety of other special gear to contribute to the development program.

The SB. 5 first flew in December 1952 and a cold examination of the time scale shows that by that time the configuration of the P. 1A must have been fixed, for better or worse. All that the SB. 5 would do was to confirm English Electric's choice of the geometry of the airplane.

Extreme sweep means other aerodynamic problems, such as tip stall and the resultant loss of aileron control. Normal ailerons, with sweep like that of the wing, were obviously out for such a high degree of sweep. Spanwise flow would all but make them useless. Movable tip ailerons, similar to the type used on the Bomarc missile, were also designed and abandoned.

Final configuration of the ailerons was horn-balanced surfaces normal to the centerline of the airplane. The horn balances, selected to give increased effectiveness, have proven unnecessary and will be dropped in the production airplanes.

Power Control

Wing loads resulting from aileron deflection on the P. 1 are primarily bending in the chordwise plane, rather than the combined spanwise bending and torsion experienced with more usual aileron layouts. This reduces the structural worries. But aerodynamacists were worried about the possibility of wing or aileron flutter with the proposed power control system; they went to a completely irreversible power-boost system on all the surfaces of the airplane.

Conical camber, now being flown experimentally on one of the P. 1A prototypes, is another of the aerodynamic features of the design. The basic wing did not have it, but data available from NACA among other sources, showed the advantages. An extended leading edge, which gives a cranked

ENGINEERS: *Contact our Technical Placement Manager for employment data.*

VICKERS® HYDRAULICS

MINIATURIZED PISTON TYPE PUMPS are made in four size series. Unit shown packs 4.3 hp in 0.9 lb.

PACKAGED HYDRAULIC SYSTEM means complete compatability of components and the responsibility for design, manufacture and performance testing by a single responsible source. Output is approx. 2.5 equiv. hp; length approx. 14"; weight approx. 13.5 lb.

PACKAGED HYDRAULIC SYSTEM provides small envelope, reduced weight, minimum piping, and "plug-in" construction for easy installation and servicing. Output is approx. 2.5 hp; length approx. 13½"; weight approx. 19.5 lb. (including power source).

ELECTRICAL POWER PACKAGE uses hydraulic system to provide closely regulated 400 cycle, AC power with minimum weight and envelope. 1 kva package shown weighs only 10.5 lb.

for Guided Missiles

As the rapidly-expanding missile program progresses, more and more applications are being found where Vickers Hydraulics will be used to advantage. Vickers has miniaturized components that can be integrated into system packages with minimum tubing . . . manifolding components gives no opportunity for leakage. These "packaged" systems with their optimum performance and *reliability* are used to power missile control surfaces. Minimum space and weight, easy installation and servicing are other important advantages. Get in touch with the nearest office listed at the right for further information.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Aero Hydraulics Division
Engineering, Sales and Service Offices:

Administrative & Engineering Center
Detroit 32, Michigan

3201 Lomita Blvd.
P.O. Box 2003
Torrance, California

District Sales and Service Offices:
Albertson, Long Island, N. Y., 882 Willis Ave. • Arlington, Texas, P. O. Box 213 • Seattle 4, Washington, 623 8th Ave. South • Washington 9, D.C., 624-7 Wyatt Bldg. • *Additional Service facilities:* Miami Springs, Florida, 641 De Soto Drive

TELEGRAMS: Vickers WUX Detroit • TELETYPE: "ROY" 1149 • CABLE: Videt

OVERSEAS REPRESENTATIVE:
The Sperry Gyroscope Co., Ltd.— Great West Road, Brentford, Middx., England

Write for new Bulletin A-5216

7645

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

appearance to the P. 1A wing, was built and is currently being evaluated in flight testing following extensive tunnel tests.

The sawcut in the leading edge of the P. 1 wings is probably the simplest of the current crop of vortex generators appearing on every British and many U. S. military aircraft. It was developed from wind tunnel tests and originally was a slit about four inches wide cut in the leading edge, just as if it had been done with a huge saw. Since its original appearance, the spanwise width of the slit has been reduced by about half. In addition to creating the high-energy vortex that re-energizes the boundary layer on the outboard portion of the wing, the slit—which has a tiny ram air duct in its leading edge—pressurizes the fuel venting system on the plane.

A nose flap at the inboard wing root was tried during the early flight development of the P. 1. The intention was to help prevent pitchup at the stall in case it developed. It didn't. But the normal tip stalling was reduced somewhat by this root flap which wasn't expected. Apparently the complex wing flow pattern is influenced by conditions which start at the wing root and which spread spanwise. Eventually the aerodynamicists decided that the root and nose flap was not so important to justify staying on the airplane, and it was removed.

Afterburners Added

The P. 1A was designed around Armstrong Siddeley turbojets rated at about 7,500 lb. thrust. Originally these engines did not have afterburners. The first prototype was later fitted with afterburning engines to bring the thrust up to about 10,000 lb. per engine. The plan was to use the Sapphires right through the program. Later Sapphires failed to appear and English Electric changed to Rolls-Royce Avons, losing more than a year of time.

The P. 1B is now flying with a pair of RA. 24R Avons, rated at 11,250 lb. each without afterburning.

The P. 1A fuselage begins with a pear-shaped simple pitot inlet leading to ducting that passed unsplit beneath the pilot and into the engines. Odd shape of the inlet was probably because of the gun-laying radar intended for the upper lip position on the day-fighter version of the plane.

The canopy is wide and flat and almost flush with the top deck line of the fuselage. From there on aft, the barrels of the engine defined fuselage size and shape.

The improved thrust-drag ratio of the P. 1B plus the need to have more radar in nose position led to the adoption of the circular single shock inlet with center body. At the same time,

HOW CALIDYNE CAN HELP PROTECT YOUR VIBRATION TEST INVESTMENT

CALIDYNE SYSTEMS ARE CUSTOM BUILT

For years, Calidyne has been building Vibration Test Systems to meet specific military, aircraft, automotive and industrial requirements. Most Systems have been custom-constructed for special applications. Although they were representative of the most modern equipment available at the time, it may now be to your advantage to modernize to meet the newer requirements of this fast-moving field.

HOW TO OUTWIT OBSOLESCENCE

Some of the older Calidyne Vibration Test Systems may have become obsolete to a point where they cannot be revamped to meet more modern requirements. With others, it is possible for us to up-grade the equipment so that its performance will compare favorably with any now being offered. In many cases this can be done without serious sacrifice of the original investment.

IT MAY PAY TO INVESTIGATE

When you want to investigate the possibility of bringing your Calidyne Vibration Test System up to date, get in touch with us here at Calidyne — we can quickly tell you what can be done. The telephone number is Winchester (Boston) 6-3810, or write:

THE CALIDYNE COMPANY
130 CROSS STREET, WINCHESTER, MASSACHUSETTS

Avionics Engineers:
MAKE AVIATION HISTORY AT RYAN

THE NEW X-13 VERTIJET is another example of the technical break-throughs Ryan is achieving in aviation. You'll find the same high level of advanced engineering in every phase of Ryan's work in avionics.

SYSTEMS ENGINEERS • SYSTEMS ANALYSTS • CIRCUITRY • DESIGN ENGINEERS • SERVO DESIGN ENGINEERS • PACKAGING ENGINEERS • ETCHED CIRCUIT ENGINEERS • MICROWAVE TECHNICIANS

Opportunities in:
- Automatic Navigation
- Missile Guidance
- Helicopter Instrumentation
- Aircraft Control Systems

Ryan is the right size for you—big enough for complete responsibility on challenging projects—small enough so you won't get lost in the shuffle. And, Ryan is located in clear-sky San Diego, world famous for beaches and casual living.

For complete details, write to JAMES KERNS—

RYAN AERONAUTICAL COMPANY
2711 Harbor Drive, San Diego 12, California

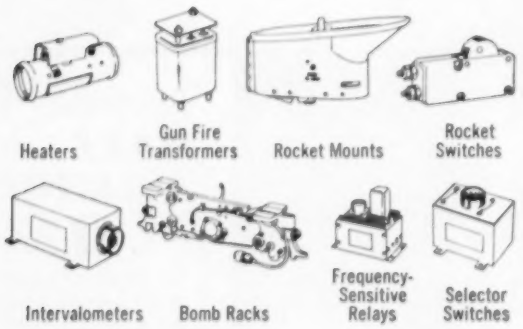
North American F-100F Achieves

COMPLETE ENVIRONMENTAL FREEDOM

Atom bomb carrier

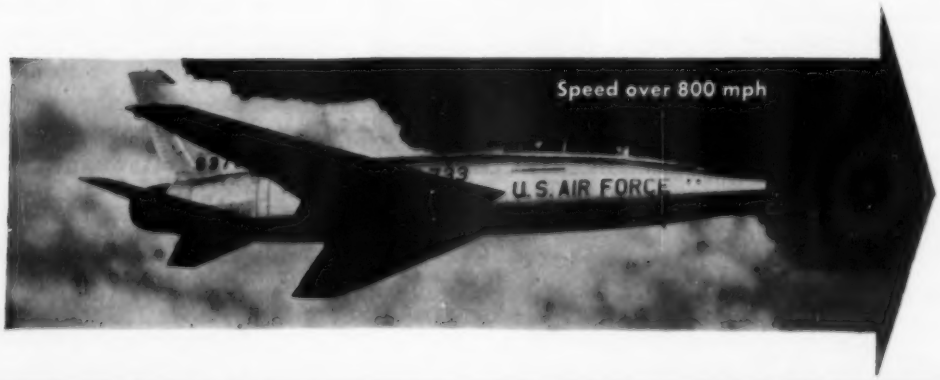
Under **all** flight conditions, North American Aviation's F-100F Super Sabre gives the pilot **complete** control over his environment. To achieve such outstanding performance, major aircraft manufacturers depend on smaller companies to develop and produce components that function dependably under the most severe circumstances.

Cole Electric Co. is proud to have engineered and manufactured these reliable components for North American Aviation, Inc.:



Cole Electric Co.

8439 Steller Drive • Culver City, Calif. • TExas 0-4701



Actual Flight Photos Courtesy of North American Aviation, Inc.

the powerplants forced other changes in fuselage details.

Experience with the earlier canopy dictated a change to a more conventional one on the P.1B. The canopy is now raised for better visibility, and, in the drag shadow of the canopy, a dorsal spine has grown to carry many of the systems formerly threaded through the fuselage under the skin.

Canopy troubles plagued the early flight tests of the machines. Both Beamont and De Villiers had them blow off. De Villiers had his go at supersonic speed and apart from "one hell of a bang" nothing serious happened. The canopies had been locked down by a simple toggle that was supposed to do the job. Under air loads and pressurization, things distorted just enough to unlock the lock. This situation has been fixed with lock redesign.

Viewpoint Changes

A 1947 Ministry of Supply specification kicked off the P.1 series design. It was belated recognition by British officials that manned supersonic flight was not extremely dangerous if the designers and pilots knew what they were doing. Before the little Bell X-1 drove the point forcibly home as it pierced the fictitious sound barrier, the official British view—deplored in many engineering offices—was that the danger of piloted supersonic flight was too great. Transonic model tests were the only answer, they had announced, in 1945, nipping at least one promising supersonic research airplane in the bud.

A handful of engineering teams—Armstrong Whitworth, English Electric and Fairey among them—were delighted at the second thoughts of the Ministry and submitted designs about two years later after the specification was issued. The English Electric proposal became the P.1 and Fairey's layout took tangible shape as the Delta 2. Both schemes were bought by the Ministry and the work began on two diverse concepts.

First influence on the design of the P.1 was the acknowledged experience of the U.S. in the supersonic flight regime. Background of the Bell X-1 series of flight tests, coupled with transonic experience in the F-86 Sabre, convinced the English Electric aerodynamicists that there was no point in going back over well-trodden ground. They drew heavily on American results, on NACA reports, on Beamont's transonic flight experience with the F-86. Then they concluded that it seemed pretty silly to develop just another supersonic research aircraft to duplicate in large measure what was already completed and integrated into design in the United States.

This recognition of earlier experience decided the project team on its basic

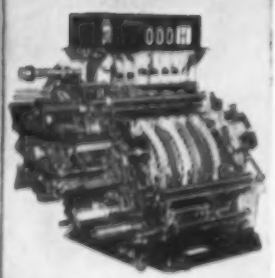
5,000 CASH REGISTER PARTS CLEANED IN 7½ MINUTES WITH

ULTRASONICS

DETREX SONICLEAN PROCESS

Thousands of hours...thousands of dollars saved by a modern miracle... DETREX Sonicleaning!

After years of service even NATIONAL CASH REGISTERS collect dust, oil and dirt. Now, a costly hand-cleaning method of preparing integral parts for reconditioning has been replaced by DETREX Sonicleaning. In this specially designed Ultrasonic Soniclean Degreaser sound waves literally "blast" the soil from the maze of parts. Three or four Registers can be cleaned at once in a few minutes with the Detrex Soniclean unit. After cleaning, quick inspection tells which parts need adjusting or replacing. NATIONAL CASH REGISTER technicians then make the unit ready for many years of additional service. The full range of DETREX services and facilities assures superior performance.



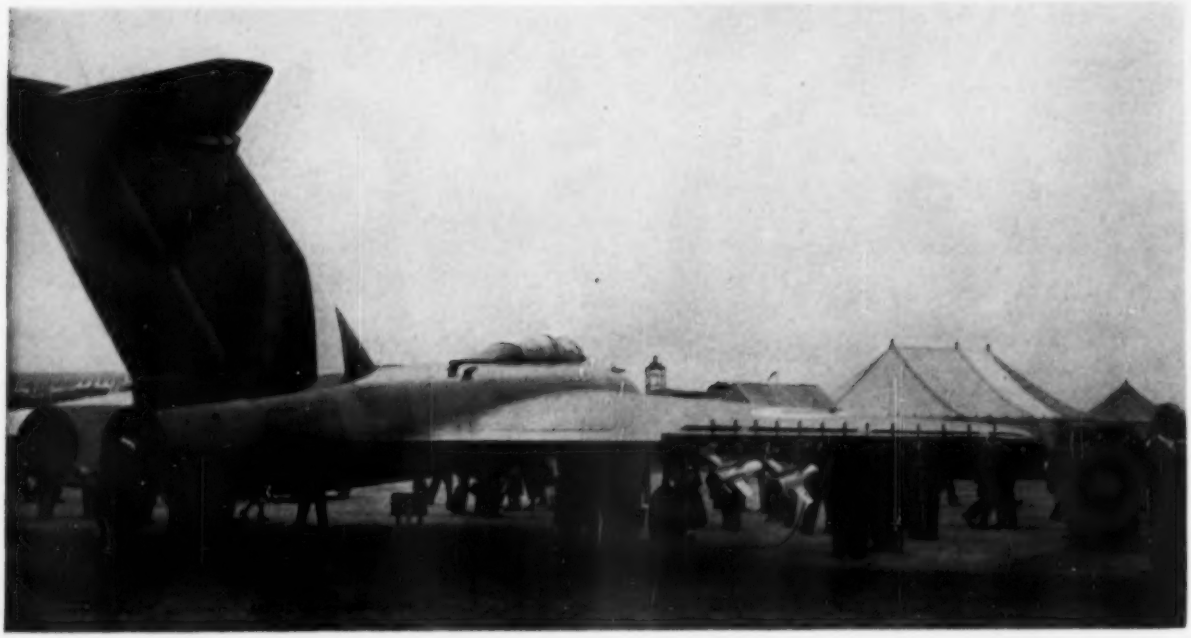
Only DETREX has Sonicleaning Installations in ALL These Applications:

Aircraft • Automotive • Household Appliances • Jewelry • Machine Tools • Electric Razors • Jet Engines • Surgical Instruments Business Machines • Electrical Equipment

Detrex, a pioneer in the Metal Cleaning and Processing Field, is now the established leader! Offering the most complete combination of chemicals, equipment, and services in the industry, Detrex can properly recommend, engineer and service any cleaning application. Write for information today!

DETREX CHEMICAL INDUSTRIES, INC.

BOX 501, DETROIT 32, MICHIGAN



Javelin Design Changes

Gloster Javelin, armed with de Havilland Firestreak air-to-air infra-red homing missiles, has vortex generators on wing, blunt trailing edges. Tailpipes have been lengthened, squared off.

approach: a supersonic research airplane that could be—with the addition of the necessary systems—a supersonic fighting airplane.

But the official view even then was that the days of the manned fighter were numbered, and there was little sympathy for the concept of a super supersonic fighting machine. English Electric produced its final design for the P. 1A as a research plane with day-fighting capability.

It took about four years for officialdom to accept the fact that missiles just weren't around the corner. In one of its continuing series of late recognition of the obvious situation, the Ministry began to show some interest in supersonic fighters driven by old-fashioned human beings.

By now the Korean war experience had sunk in and, among other points, had emphasized the importance of visual aids for the pilot flying in transonic combat. Radar for day fighters was one of the answers, and the incorporation of that into the P. 1 began. Somewhere along the line, the designers thought that a little extra space and weight could make it a all-weather airplane.

That's basically how the P. 1B evolved.

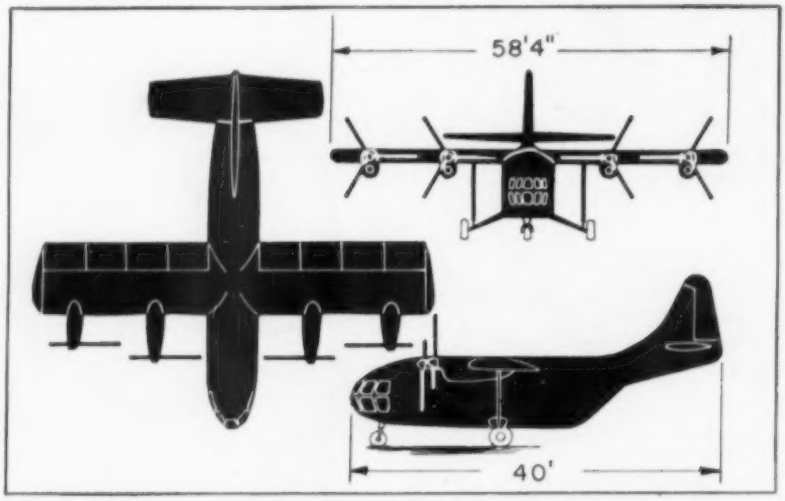
First prototype P. 1A lifted off the runway at Boscombe Down on Aug. 4, 1954, with Roland H. Beamont, English Electric's chief of flight operations, at the controls. The second prototype flew a little less than a year later in July 1955. Both prototypes have since logged more than 600 flights and have been extremely useful in developing the B series.

A third prototype, built as a static-test airframe only, was tested to destruction according to program in the structural development.

First of the development batch of P. 1Bs flew April 4 this year and since then has been joined by a second B that is now also on flight status.

Program for the series envisioned, in addition to the three P. 1 aircraft listed above, three prototype P. 1B aircraft and a pre-production batch of 20 planes.

Production tooling was to be used throughout, even for prototype manufacturing, and the line was to start with a slow initial rate of build up. This scheme, frankly modeled after



Breguet 940 Is Short-Field Plane

Breguet 940 "Integral" requires less than 300 ft. of runway, is designed for unprepared field operations. Plane uses blown wing principle, the entire wing being placed in the slipstream of the propellers.

produce a large number of airplanes ready for complete systems evaluations and service testing before the major portion of the aircraft program was committed.

Major reason for this was the Swift fiasco, which might have never happened had a similar production plan been used.

Third Prototype

The third prototype P. 1B should be nearing the end of its construction phase by now and conceivably this aircraft could join the flight test work along about the beginning of this forthcomming year.

The airplanes already have been flown by experimental test and service pilots of the Royal Air Force, as well as by Beamont and the company's chief experimental test pilot, Desmond De Villiers.

First production airplanes should start reaching the RAF in another year, so that first-line squadron of the P. 1B could be operational in the middle of 1959.

See Long Life

Service life of the airplane could be a long one, with the airplane progressing through its interceptor task to possible roles as a ground support attack type, as and if the interceptor missiles begin to shoulder one of the P. 1's mission.

There is much enthusiasm for the airplane outside the company. First reactions of the RAF have been encouraging to the engineers who slaved on the design.

Today there are advanced versions of the P. 1 being carried through design stages in the firm belief that the missile is not for a very long time, going to take over completely from the manned interceptor.

Test 180-deg. Camera In Grumman F9F-8P

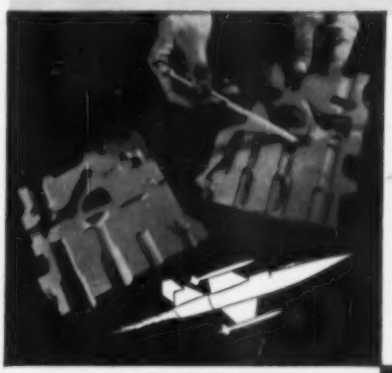
Horizon-to-horizon aerial photograph of mid-Long Island taken by a new, light-weight Perkin-Elmer wide angle camera which appeared in AVIATION WEEK Sept. 16, p. 76, was taken from a Grumman F9F-8P.

Plane was flying at altitude of 7,000 ft. and air speed of approximately 350 kt. which is the optimum photographic speed for the panoramic camera at that altitude.

Pilot of the plane during this first mission for the new camera was Lt. Cmdr. John F. Condren. He is Deputy Director of the Aeronautical Photographic Experimental Laboratory, Naval Air Development Command, Johnsville, Pa., which is coordinating flight testing of the camera.

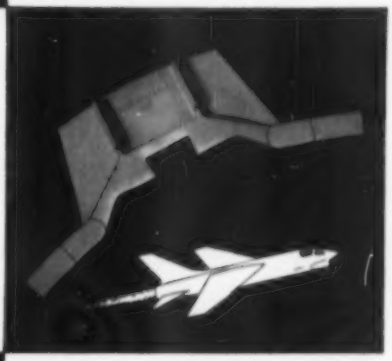
For aviation and rocketry of today and tomorrow, component steel parts of highest performance will be

CAST BY LEBANON



FOR THE LOCKHEED STARFIGHTER
A flow divider and fuel selector for the afterburner of the J79 jet engine, CAST BY LEBANON in a precipitation hardened stainless steel. Lebanon foundry engineers developed a special coring material to achieve the close tolerances and smooth surfaces required in the internal passages. This casting must perform at high pressures and elevated temperatures.

FOR THE CHANCE VOUGHT CRUSADER
A support fitting for a jet engine removal track, CAST BY LEBANON in precipitation hardened stainless steel for the close tolerances, dimensional accuracy and surface smoothness required by the design. A significant example of how Lebanon foundry engineers were able to successfully produce a casting which substantially retained the original characteristics of a machined part, at a major cost saving.

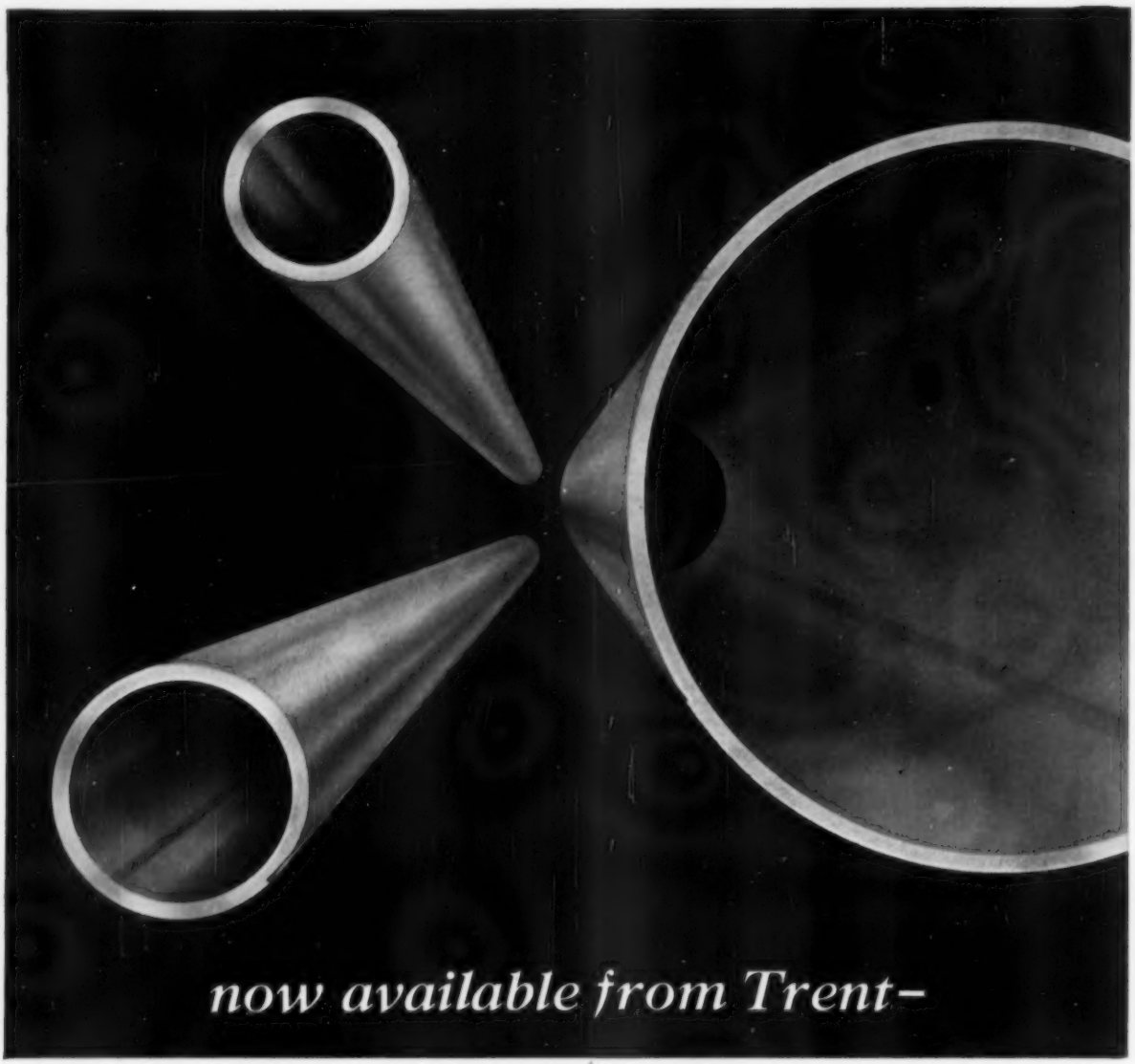


FOR A ROCKET YET UNNAMED
A nozzle ring for a prototype rocket engine by Reaction Motors, Inc., CAST BY LEBANON in stainless steel. Representing the ultimate in casting design and production, this casting requires absolute accuracy of core placement, close tolerances, and thin metal sections. These exacting requirements foreshadow the foundry techniques of the future, now being employed at Lebanon *today*.

DESIGN AND PRODUCTION ENGINEERS: If you would like case histories of these castings, together with the metallurgical data, process development and applications to your design project, write to Lebanon and ASK FOR DESIGN FILE F.

CIRCLE L

LEBANON STEEL FOUNDRY
63 LEHMAN STREET
LEBANON, PENNSYLVANIA



Titanium Tubing

For processing lines carrying fluids of an extremely corrosive nature — look to *Contour Trentweld* titanium tubing for reliable service.

This titanium tubing is completely uniform throughout any cross-section. The weld zone is free from bulging weld bead because Trent's exclusive process — performed with the weld area at the bottom — forms the molten weld metal into the shape of the tubing.

And, with titanium, you get the unique advantages of a tubing that's strong as steel but 44% lighter . . . virtually immune to a broad spectrum of corrosive materials . . . entirely free from stress-corrosion cracking.

So, next time you need a strong, light, extremely corrosion-resisting tubing — try *Contour Trentweld* titanium tubing. And remember, it's made by Trent — tube mill specialists.

CONTOUR TRENTWELD

Stainless and High Alloy Welded Tubing

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of Crucible Steel Company of America)

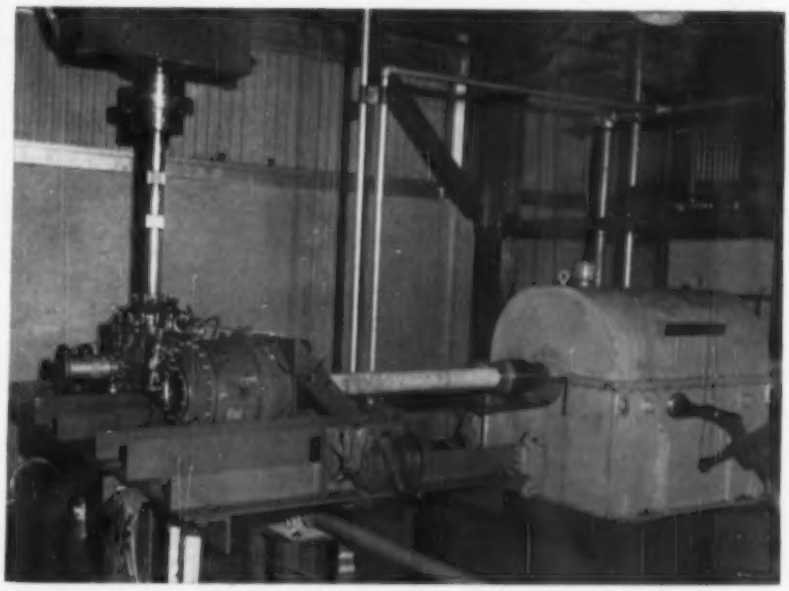
Bell Tests H-40 Drive for Durability

By Craig Lewis

Fort Worth, Texas—Bell Helicopter Corp. is currently testing a drive system for the H-40 turbine-powered helicopter which is designed to give the H-40 a 1,000 hour life between overhauls.

Transmission and the rest of the drive system on the H-40 were designed for simplicity and long life, and the system is going through an extensive test program here to prove that it is a reliable 1,000 hour overhaul item.

Tests on the H-40 drive system are part of an overall test program on the new utility helicopter Bell has designed for the Army. Bell expects the program to prove the H-40 represents a breakthrough in operating economy, serviceability, reliability and performance. Bell says its new helicopter will be the first to offer 1,000 hour overhaul periods.



BELL H-40 transmission test rig shows transmission (left rear), speed-up gear box (left front) and fluid coupling (right). Vertical shaft goes to dynamometer overhead.

Drive System Test

While the XH-40 prototypes are going through their flight test programs, Bell is bench testing the helicopter's drive system in a rig which simulates turbine power and flight conditions. The X phase of the testing has been completed after 450 hours. In the Y phase, Bell will run the drive system through 1,000 hours of testing to prove that the original design, plus some changes developed from X phase testing, represents a 1,000 hour system.

The transmission and drive system for the H-40 were designed specifically for ease of maintenance and speed of removal and replacement. Designers used actual time-of-removal criteria in developing the system. Simplicity was an essential consideration, and Bell engineers have used the same parts throughout the system wherever possible.

System's bearings offer one example of simplicity. One bearing can be used in 11 places, greatly simplifying logistics problems in maintenance. Tail rotor drive shaft has five sections, all interchangeable. Shaft is secured by Marmon-type clamps for easy demounting, and the engine-transmission drive shaft is also secured by this type of clamp.

Bell engineers designed the transmission and system with the fewest number of different pieces possible. They also tried to avoid the need for special tooling for maintenance. Wherever possible, they determined what tools would be available to the crews which would maintain the H-40, then designed a system to be handled with these tools, plus a minimum of special tools.

Another feature of the transmission that lends itself to easy field maintenance is simple exchange of bevel gears. A bevel gear quill can be replaced in the transmission with no shimming required, eliminating the complicated adjustments required in former helicopter transmissions.

Daily maintenance problems are simplified by the fact that the oil level in both the transmission and the two gear boxes in the tail rotor drive system can be checked by sight glass.

Since the H-40 is powered by the Lycoming T-53 free turbine engine, Bell was able to simplify its system, and save about 75 lb., by eliminating the clutch required by piston-powered transmission systems. Transmission reduces the T-53's speed of approximately 6,000 rpm. by about 20-1 through bevel gears and a two-stage planetary system.

Test Facility

Bell is proving out its drive system design on a test rig housed in a Navy-financed facility at the company's Texas plant. Facility is built to accommodate single rotor systems up to 2,500 bhp. and dual rotor systems up to 5,000 bhp.

Power for the test facility comes from a 2,000 hp. power package taken from an HSL-1 helicopter. Engine is a Pratt & Whitney R2800. Maximum horsepower used in the test cycles is the 840 bhp. specified for the T-53.

To simulate a turbine-type power flow, the R2800 engine is hooked to a gyrol fluid coupling and a speed-up gear box. Fluid coupling removes torque impulses from the piston engine, simulating the smooth torque delivery of the T-53. Then the gear box, which is a modified HSL-1 forward transmission, increases coupling output speed nearly three to one.

Simulated turbine power is delivered to the H-40 transmission and through the drive system to dynamometers which simulate main rotor and tail rotor loads. A Clayton water brake dynamometer provides tail rotor load, and main rotor load is provided by a G.E. horizontal type induction dynamometer.

Simulate Autorotation

A right angle gear box is used to transmit power from the main rotor mast to the dynamometer. A 50 hp. electric motor is connected to the shaft with a chain drive to simulate autorotation and free-wheeling unit overrunning. The H-40 drive system is equipped with a free-wheeling clutch to permit autorotation.

While the drive system is undergoing bench tests, the three XH-40 helicopters are also developing data on the system in flight tests. The fact that bench testing of the drive system began six months before flight test has been important in keeping the whole program moving along. Charles W. Bowen, Jr., Bell engineer supervising the bench test, says the transmission program has managed to stay ahead of flight testing and "there has been no down time for lack of transmission knowledge."

Testing of the Y configuration drive system is scheduled for completion at

the same time service testing of the YH-40 is finished so when the production H-40 is ready, Bell can assure the Army of a 1,000 hour overhaul item.

Tests so far have developed no configuration changes in the transmission or drive system, but several minor changes have been indicated in the debugging program. Faulty lubrication caused some early bearing failures before the system was modified to correct this and other problems.

Bell will switch to a regenerative test system using two transmissions back-to-back with a low horsepower motor for spot checking and running-in production transmissions. This is cheaper and easier than running transmissions in on a helicopter as was done with the piston-powered HSL.

Highly Precise Hydraulic System Alters British Windtunnel Nozzle

London—Britain's 8-ft. supersonic windtunnel at the Royal Aircraft Establishment, Bedford, has a number of unusual design and control features not yet found in any U. S. tunnel.

The $30-million tunnel is designed to cover subsonic and supersonic speeds up to Mach 2.8, with air pressures from 0.1 to 4 atmospheres absolute. It is an 820-ft.-long closed circuit structure.

Variable Nozzle

Its infinitely variable nozzle is formed by flexible plates, one in. thick, 62-ft. long and 8-ft. wide, located at the top and bottom of the working section. These plates can be contoured by a system of hydraulically-motored, tape-controlled screw jacks.

Each of the plates is carried on 30 pairs of these 30-ton mechanical jacks, each pair driven by a separate 5-hp. rotary hydraulic motor.

Precise Control

Operated through a master tape, the jacks can be simultaneously inched in increments of either 1¼ or 2½-thousandths of an inch to flex the plate into any desired nozzle profile while the tunnel is on stream. To effect this degree of precision, a hydraulic amplifier valve was developed that is sensitive to a mechanical input motion of 0.0005 in.

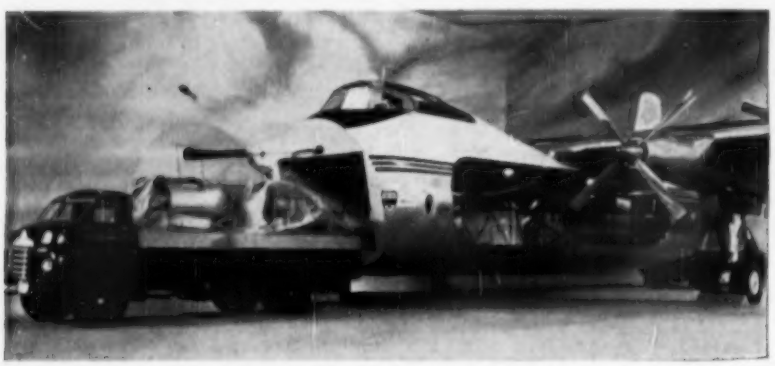
The makers believe this valve will prove of considerable significance in hydraulic control systems generally.

Like other tunnels of this type, the subsonic flow is controlled by varying the compressor speed while supersonic flow is developed and regulated by the shaping of the working section nozzle. To slow the airflow down once past the model to subsonic speed for re-entry to the compressor, a diffuser section of the same physical size as the working section nozzle is required.

Special control systems are provided in the Bedford tunnel to shape the nozzle and diffuser, control the compressor speed and control the movements of the aircraft or missile model.

In order to provide shockfree and uniform flow past the model, the curvature of the walls in the working section has to be accurate to within 0.005 in. between each jacking. This requires precise control of each jacking station throughout the speed range of the tunnel, while the movements must be capable of being made while the tunnel is sealed and the compressors running.

In the diffuser, accuracy of control is not so critical, only 0.050 in., and the design takes the form of movable



Freightercoach Model

Armstrong Whitworth AW. 650 passenger/freight design is shown in model form above. The medium-sized "freightercoach" will be turboprop-powered. Two prototypes of the aircraft are under construction and several airlines are said to be interested.

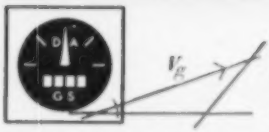
RADAN IS READY

• RADAN commercial version of GPL's famous airborne Doppler auto-navigation systems

• RADAN the global guide for which civilian aviation has been waiting

is now available!

RADAN SYSTEMS



ground speed & drift angle
any time, anywhere, any weather

One look and the pilot KNOWS. In a glance he reads actual ground speed and drift angle, displayed on his flight panel – automatically and continuously.

The system operates entirely without ground aid or celestial fix.

RADAN is the result of GPL's harnessing of Doppler for air navigation – an achievement comparable in magnitude to the breaking of the sound barrier.

...and now for everyone

The wraps are off RADAN! The civilian counterpart of GPL's famous military Doppler auto-navigators, is ready and available *now* – for anyone and everyone!

RADAN Systems have behind them millions of miles of experience in transcontinental, oceanic and polar flights . . . save precious time and fuel . . . provide a priceless margin of safety.

- **RADAN** – accurate: within 1% for ground speed, within ½° for drift angle
- **RADAN** – small: 4.4 cu. ft.–light: 89 lbs.
- **RADAN** – operates without ground or celestial aids
- **RADAN** – virtually maintenance-free

Now in quantity production, RADAN Systems are manufactured by GPL, who developed and is the nation's leading producer of Doppler air navigation systems. Address inquiries to: General Precision Laboratory Incorporated, Pleasantville, New York.

GPL
A SUBSIDIARY OF
GENERAL PRECISION EQUIPMENT CORPORATION
GPE

ENGINEERS – GPL achievements have opened up some unusual research and development opportunities. Send resumé to Personnel Manager.

panels on either side of the tunnel with adjustable air inlet doors providing a bypass circuit.

The hydraulic amplifier valve is of the piston type, is of simple construction and has extraordinary sensitivity. Features are incorporated for the control of both frequency and amplitude of dither in the sensitive valve and for speed response in the main directional valve.

Rig testing showed that changes in local temperature in the vicinity of the sensitive valve of only a few degrees could be made to inch the main hydraulic valve on load. This sensitivity was dulled for stability reasons.

The jacks and reduction gears are mounted in transverse pairs, together with the driving motors and main directional valves, on substantial platforms, which pivot on trunnions on the main frames and allow the jacks to swing when the various nozzle profiles are being formed.

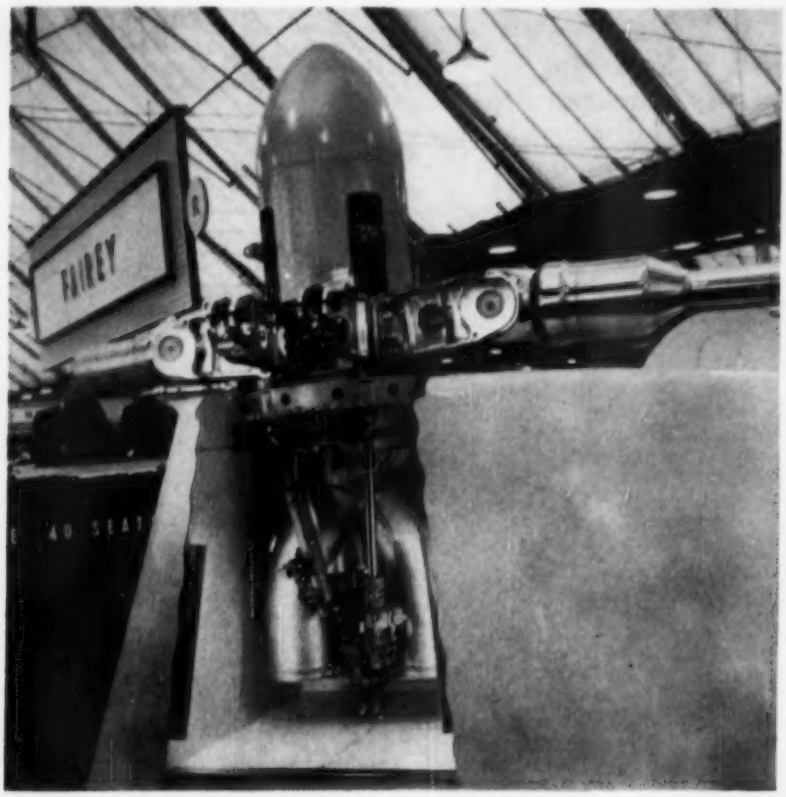
The plate thickness was machined to better than 0.010 in. Nozzle profiles can be formed to within 0.005 in. of the theoretical shape required and slopes between irregularities are kept to better than 1:1000.

The whole of the working section weighs 400 tons and is supported at three points. The downstream point is fixed and the other two are roller supports.

Main compressor of the tunnel is the largest in Europe. It is a 10-stage axial machine driven by a 68,000-hp. 8-pole synchronous motor connected through a gearbox to two 6,000-hp. dc. pony motors connected in tandem.

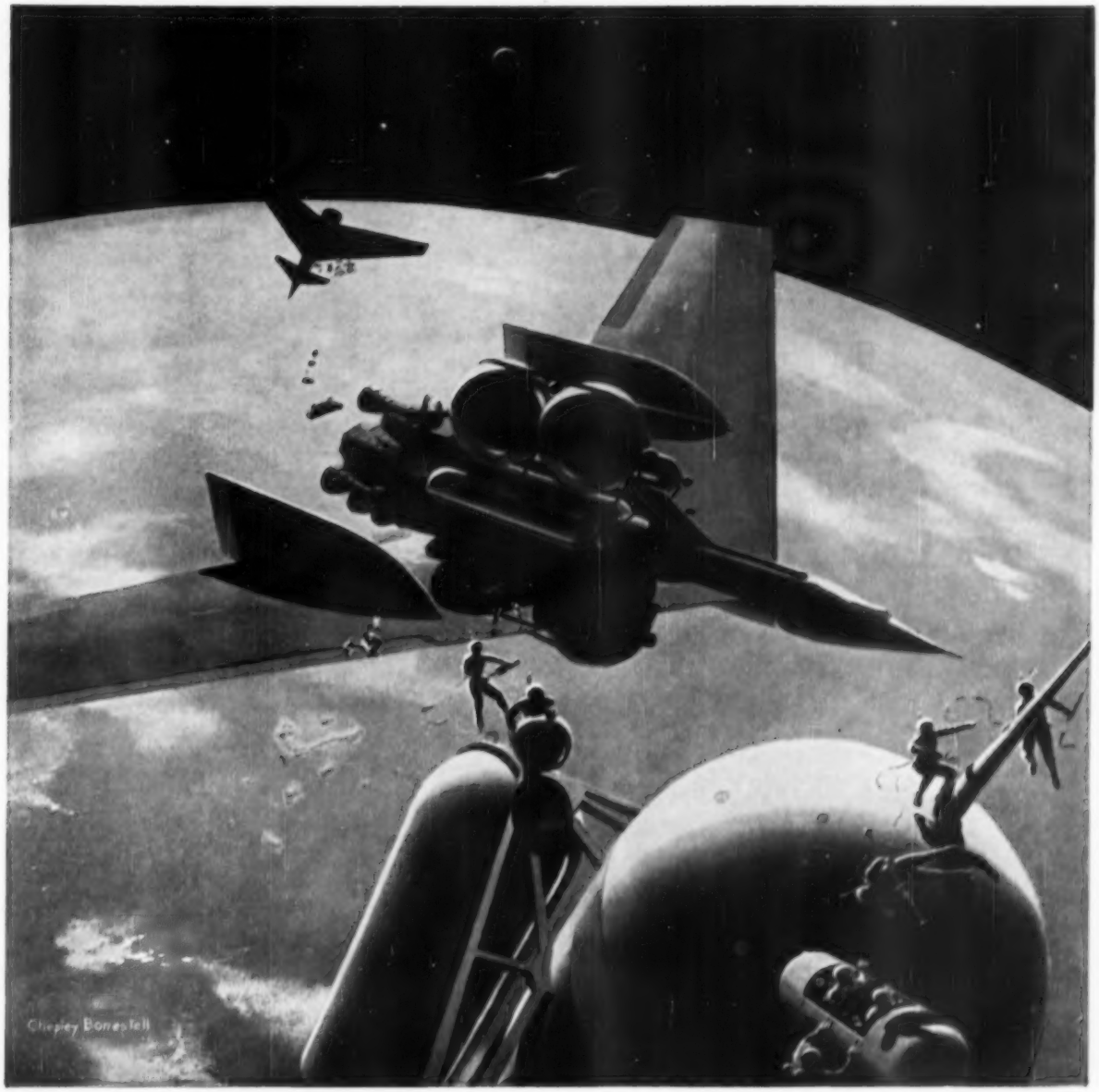
Three methods of operation are possible:

- **For subsonic work** on reduced loads, the compressor can be driven by the 12,000 hp. motors alone, with the 68,000-hp. machine disconnected, providing a speed range of 150/750 rpm.
- **For high power,** the 68,000-hp. can be run at a fixed speed of 750 rpm., drawing its supply from the national grid system with the dc. motors contributing 12,000 hp.
- **For full power** variable speed working, the main 68,000-hp. motor is driven from a variable frequency supply from 10c/s-50c/s generated by two 20-mw. gas turbine generating sets.



Rotodyne Rotor Details

Rotor and hub (above) for Fairey Rotodyne, now being completed at company's plant (below), shows the ducts for the pressure-jet air flow. Air from the Napier Eland turboshaft engines; which also drive the forward motion propellers, is supplied to the four hollow helicopter blades where it is burned in tip jets for vertical flight.



Painting by Chesley Bonestell from the book *The Exploration of Mars* by Willy Ley, Wernher Von Braun and Chesley Bonestell, published by Viking Press ($4.95). ©C.B.

How do you control temperature on space ships?

The answer is — you don't. The controls do — controls that act many times faster than a man can react. Controls are the real key to all problems beyond sound and heat barriers.

It would be easy to list here the part Fenwal has played in the ever-progressing field of aircraft temperatures, over-heat detection and other controls. But this would only be repetitious. The aircraft industry is well aware of it.

Rather, Fenwal prefers to restate its position for the future. Fenwal is prepared by *experience . . . with equipment . . .* and *through its manpower* to work ahead with you whatever the stage of your current problems. Of this you may be sure: Fenwal's present equipment already enables the most modern advances in its field.

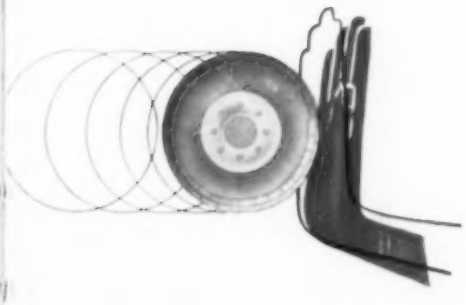
This is well typified by Fenwal's advanced position in power plant controls through thermocouples, harnesses and special engine accessories.

To enlist Fenwal's ability to help meet *your* present and future control problems, write Fenwal Incorporated, Aviation Products Division, Ashland, Massachusetts.

Fenwal *Controls Temperature . . . Precisely*

America's first jet airliner...
BOEING 707...relies on ***hytrol***
the accepted anti-skid braking system

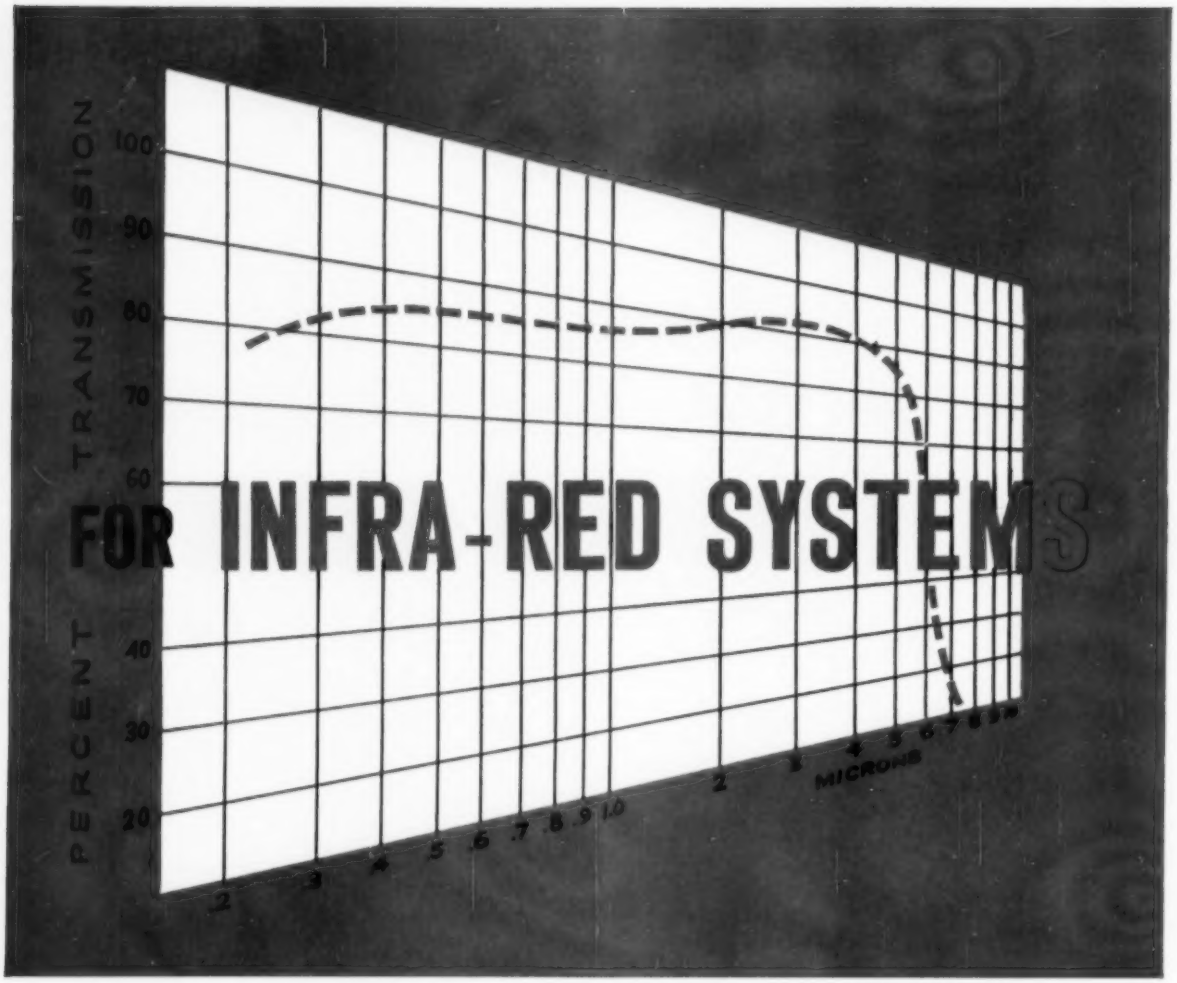
Color reproduction courtesy of Boeing



HYTROL means "Happy Landings" for tomorrow's airline passengers. The comfort of cruising 7 miles up in the new 707 will be matched by the comfort of a landing masterminded by the accepted anti-skid braking system . . . proved as standard equipment on such military aircraft as the KC-135, B-52, B-47, F-101, A3D, RB-84F, F-100, C-118, C-130, QF-80. Hytrol "happy landings" will help you sell more airline tickets in the competitive jet age just around the corner. Shouldn't you be thinking about the advantages that *HYTROL* can offer your passengers on your present equipment . . . right now?

Every fighter, Every bomber, Every transport is Hydro-Aire equipped.

HYDRO-AIRE
3000 WINONA AVE., BURBANK, CALIF.
aviation subsidiary of CRANE
Who make Hy-v/l Fuel Pumps, Hytrol, Fuel Gate Valves, Hot Air Valves, Electro-Aire Motors.



SPECIFY LINDE Sapphire

TRADE-MARK

LINDE Sapphire is . . .

Hard—Moh 9
Transparent, single crystal, pure aluminum oxide
Nonporous—0% porosity
Easily sealed to metals and ceramics
Priced competitively with sintered materials

LINDE Sapphire has . . .

Strength at elevated temperatures
High melting point—2040° C.
Excellent IR transmission at high temperatures (above 500° C.)

LINDE Sapphire is available as . . .

Windows
Domes
Rods and tubes
Special shapes—to order

For more information about LINDE Sapphire . . . Write "Crystals Dept. AW-95," LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. *In Canada:* Linde Company, Division of Union Carbide Canada Limited

Linde

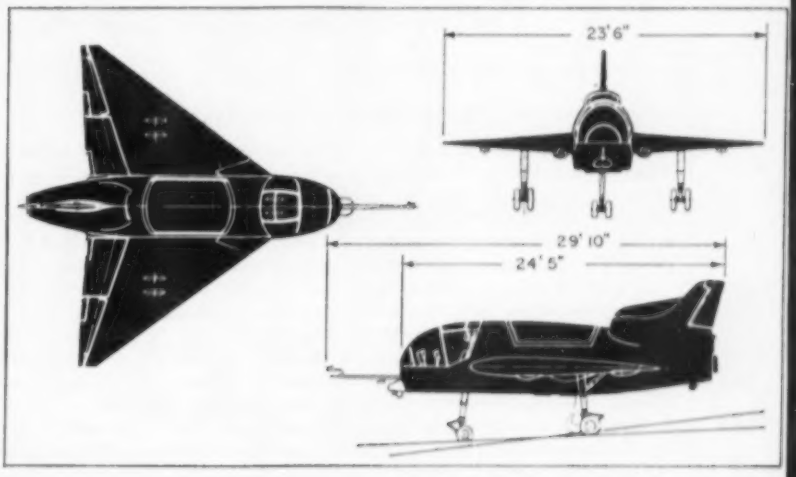
UNION CARBIDE

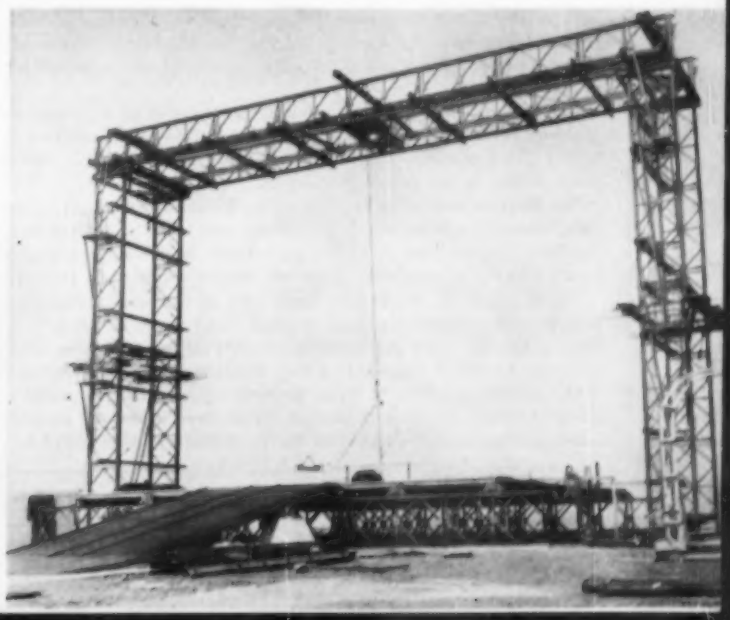
ENGINEERS AND SCIENTISTS interested in working in Synthetic Crystal Sales & Development, contact Mr. A. K. Seemann, Linde Company, 30 E. 42nd St., New York 17, N.Y.

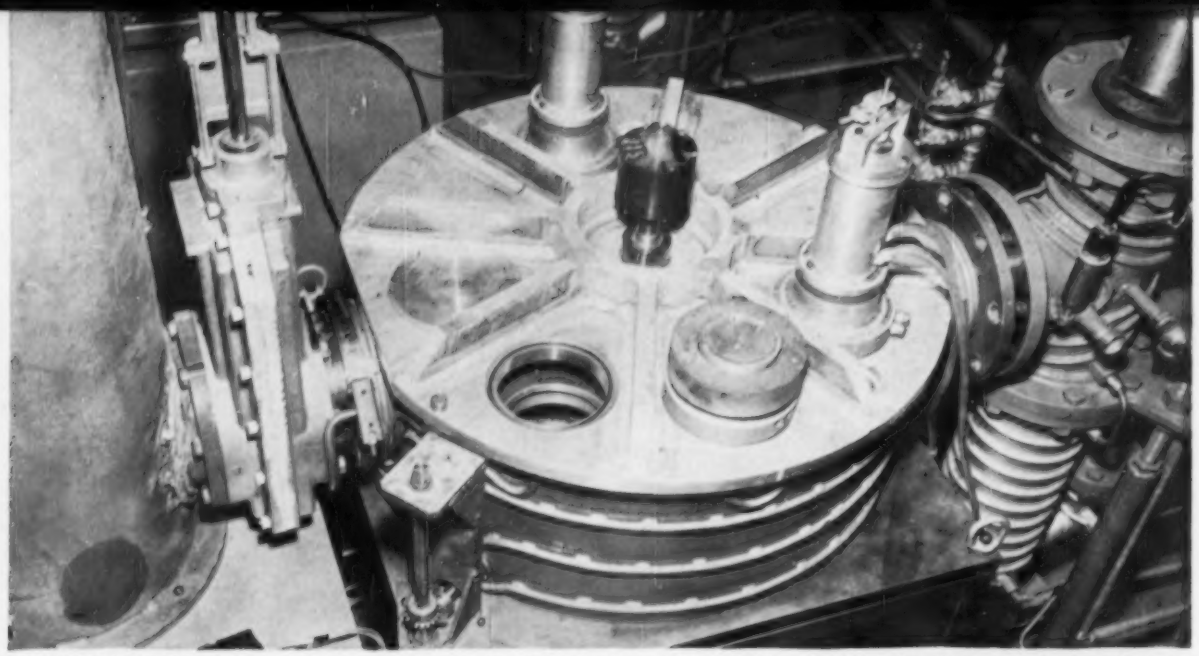
The terms "Linde" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

Short SC.1 VTOL Uses 5 Jet Engines

Short SC. 1 VTOL research aircraft is powered by five Rolls-Royce RB. 108 high thrust-weight ratio jet engines. Three-view at right shows their common air intake just ahead of the vertical tail. Forward flight tests have been completed and the aircraft will soon begin hovering trials with safety cables attached to a gantry (lower right) in case of a mishap. The SC. 1 is standing before a large fan in the lower left photo during a canopy jettisoning test.







WIDE VARIETY of high temperature components suitable for operation at 500C or higher can be produced by vacuum-evaporation process which opens ways to using many new materials. Facility above is designed for semi-automatic metal-film potentiometer production.

New Techniques, Materials for 500C

Surprising Development

Activity of Servomechanisms, Inc. in the field of basic component technology may come as a surprise to a large segment of the aviation industry which knows the company primarily for its sub-system work (such as air data computers) and as a manufacturer of servo system devices.

Tip-off on the firm's progress in component technology came about a year ago when Servomechanisms was one of two firms selected by Wright Air Development Center to develop capacitors capable of operating at 500C temperatures, despite heavy competition from established capacitor manufacturers.

Servomechanisms first entered the components field in a very limited way about seven years ago out of necessity, not with idea of diversification. In designing analog computers for its sub-systems, company found that accuracy was limited by minimum resolution obtainable with then-existing wire-wound potentiometers.

Company therefore started work, with own funds, on development of continuous metal-film potentiometer which offered much finer resolution. Wright Air Development Center contract followed in 1951 to support part of the effort.

Crux of the problem was development of techniques for depositing thin, uniform layer of metal film to provide required linearity. Servomechanisms turned to the vacuum-evaporation technique, as did Fairchild Camera & Instrument Co. and Technology Instrument Corp., both of which now produce precision film potentiometers by this process.

But Servomechanisms soon encountered a number of solid-state and surface-effect problems for which it had no answers. For example, it found that the crystal structure of the film controlled its electrical properties and this in turn depended upon many factors in the evaporation process.

To obtain answers, company formed small research laboratory, staffed it with physicists, chemists and metallurgists. About same time it formed the Vacuum Film Products Division here at El Segundo, Calif. to develop and produce various electronic components utilizing improved vacuum-evaporation techniques.

On the strength of company know-how in the vacuum-evaporation process and new materials, Servomechanisms received about two years ago a WADC contract to develop techniques for producing extremely thin magnetic films, with square hysteresis loops, for use as magnetic memory elements. A year later came the contract for 500C capacitors. Office of Naval Research sponsored development of technique for using vacuum-evaporation to produce temperature sensor and currently is considering additional sponsorship because of the promising results achieved to date.

By Philip J. Klass

El Segundo, Calif.—Wide variety of different electronic components capable of operating at temperatures of 500C or higher may be close at hand as result of fundamentally new techniques and materials developed here by Servomechanisms, Inc.

The development, which also may permit automatic production of complete circuits and sub-assemblies, could have a significant impact upon both avionic component and equipment manufacturers.

Servomechanisms has extended the vacuum-evaporation process, currently used to make metal film potentiometers, to deposit thin films of insulating and semiconducting material as well as conducting films.

This opens door to using new high temperature materials whose mechanical properties previously prevented their use in conventional component manufacturing processes.

Experimental Fabrication

Company has fabricated experimentally, or on pilot run basis, a wide variety of devices using the vacuum-evaporation process. These include: potentiometers, capacitors, resistors, inductors, diode rectifiers, pulse transformers, strain gages, thermocouples and magnetic memory elements with response times of milli-microseconds. (Most of these were not suitable for 500C operation, but were fabricated to

MATERIAL is heated in vacuum chamber until its surface begins to vaporize. When vaporized material strikes cooler component core, it deposits in thin film.

Components

prove the feasibility of using the vacuum-evaporation process.)

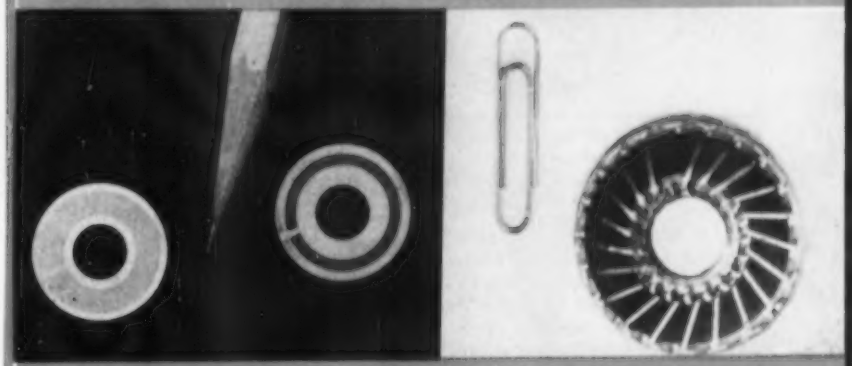
One of company's long range research goals is to develop materials and techniques for producing transistors by the same process, according to Ralph Redemske, vice president of research. Redemske is encouraged by success in producing deposited diodes. Company will soon attempt to produce complete computer diode matrices by vacuum-evaporation process.

Because the depositing of a thin film of conductor, semiconductor or dielectric material must take place in a high vacuum (about 0.2 micron), a high degree of automation is required for the process. While this means a higher initial investment than required for conventional component manufacturing, automation should lower unit costs and increase component reliability. Fabrication in a high vacuum should also keep out impurities which cause unpredictable component failures.

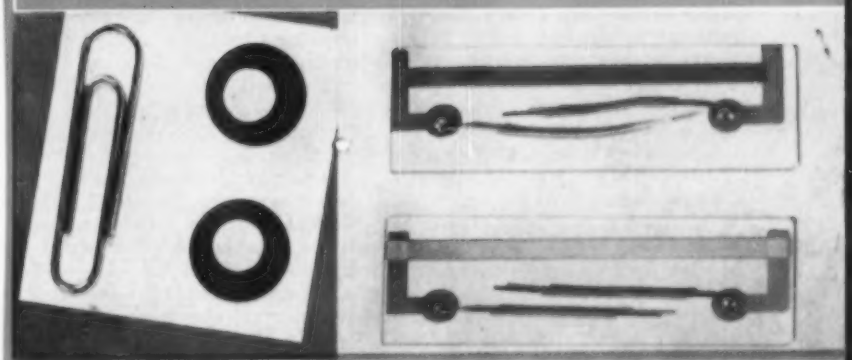
One measure of the promising potentialities of the Servomechanisms program is the fact that portions of the effort are being supported by USAF's Wright Air Development Center, Army Signal Corps, and the Office of Naval Research.

The vacuum-evaporation process is simple in concept but requires considerable skill and know-how for successful application to precision components. When any material is heated to a sufficiently high temperature, its surface layer will vaporize—much as water

MANY different types of components that can be made by vacuum-evaporation process are shown in samples above and below. Above, left, are deposited temperature sensors. Above, right, are deposited magnetic memory elements for computers.

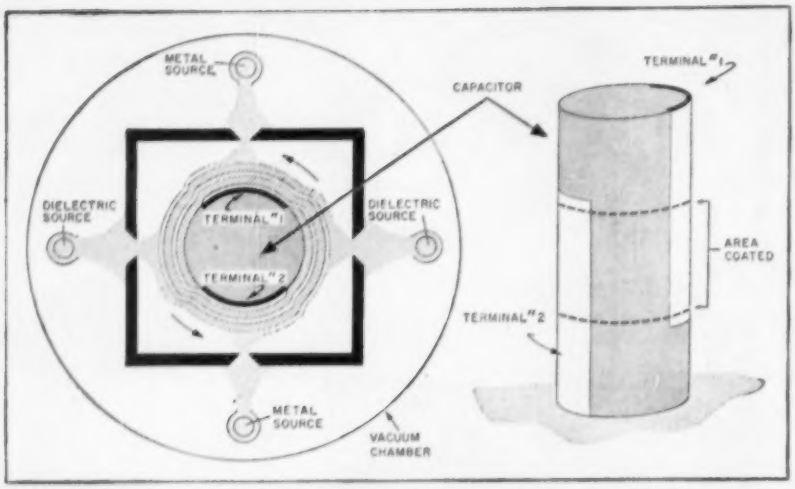


PRECISION potentiometer element (left) has deposited terminals, center tap, and metal resistance film. Experimental transformer (right) consists of two 10-turn windings, magnetic film and dielectric, all deposited by vacuum-evaporation process.



500C disc capacitors, in 200 mmfd. size, have alumina film and gold plate deposited. Test samples of evaporated resistors for 500-600C operation are shown at right.

DISASSEMBLED potentiometer shows deposited metal film element (center).



MANUFACTURE of larger-size deposited capacitors uses alumina core which is exposed to two sources of metal vapor and two sources of dielectric vapor through four slits in mask (black). As core rotates, alternate layers of metal and dielectric are deposited.

turns to steam at 100C temperature (at sea level atmospheric pressure).

If vaporization takes place in a high vacuum, the vapor escapes from the surface at high velocity and travels across the vacuum chamber until it impinges upon an exposed surface where it is then deposited.

By placing a suitably shaped mask between the material source and the exposed surface, any desired shape of deposit can be obtained and its dimensions can be controlled to within 0.001 in., according to Redemske. By using conductor material, deposited circuitry can be produced with considerably better dimensional control than possible in conventional printed circuitry, Redemske says.

When process is suitably controlled, it is possible to produce films of "practically any material in thicknesses ranging from single atomic layers up to several thousand Angstroms," according to David W. Moore, manager of company's Vacuum Film Products division. (One Angstrom equals 3.94 x 10^{-8} in.)

Thus the technique opens the way to using a variety of new high temperature materials which otherwise could not be fabricated in the required form and/or thickness needed for making components, Moore says.

Fabrication Technique

Here is how the technique can be applied to make a high-temperature equivalent of a conventional paper capacitor. A small alumina cylinder, whose dimensions are partially determined by the required capacitance, serves as the core. It is placed in the center of the vacuum chamber on a motor-driven pedestal.

Located around the periphery of the vacuum chamber at 90-degree intervals are four sources, two of dielectric material, two of metal conductors, alternately spaced. (See sketch above.) Initially a mask with two slits is placed around the core so that the two slits face the two metal sources.

The metal sources are brought up to vaporization temperature by electron bombardment. The streams of metal vapor emitted pass through the two slits, depositing terminal stripes along opposite edges of the core to provide electrical connections to the capacitor.

The mask is now replaced with another that has four slits, positioned so that each slit faces one of the four conductor/dielectric sources. When the four sources are brought up to vaporization temperature, streams of vapor pass through the four slits and deposit alternate quadrants of the core with metal and dielectric films.

When the pedestal motor is started and alumina core begins to rotate, alternate layers of dielectric and metal film are successively deposited to build up the familiar capacitor (jellyroll) construction. Each of the two films formed is connected to one of the terminal stripes initially deposited.

Capacitance of the device is measured continuously during the fabrication process, enabling operation to be halted automatically when required value of capacitance is obtained.

New Automatic Facility

Under Signal Corps contract, Servomechanisms is constructing an automatic facility for making precision metal film potentiometers by the vacuum-evaporation process. Facility is designed to turn out 30 potentiometers per hour. Contract calls for potentiometer linearity of 0.5%, but Moore hopes to achieve 0.1 to 0.2%.

An eight-station rotating turret built into the vacuum chamber will perform all of the critical operations under a single "vacuum roof." Ceramic discs, manually loaded into a magazine, will automatically feed into the first station of the vacuum chamber where end terminals will be deposited. The metal film will be deposited in succeeding stations after which its resistance will be trimmed automatically as required to match linearity of a master reference.

Potentiometers initially produced in the new facility will be rated for two watts dissipation at 150C operating temperature. With existing materials, this limit may be raised to 200C, but the basic investigations now under way in company's research laboratory near Santa Barbara, Calif. are aimed at turning up new materials suitable for 500C pots.

Significant progress has been made in this direction, Redemske says.

New Materials Seen

The ability to use almost any material in the vacuum-evaporization process, coupled with fundamental knowledge of solid-state physics coming out of transistor-inspired semiconductor research, has opened vast new areas for materials investigation. Where previously component makers were limited to using materials provided by nature, today it is becoming increasingly possible to create new materials with properties that meet specific requirements.

For example, a non-conducting material such as silicon becomes a semiconductor when a tiny amount of impurity is introduced into its crystal structure. Wide range of resistivities can be obtained by choice of impurity and amount used.

The 500C component goal poses many interesting challenges to the materials researcher because the component should, if possible, be able to operate also at room temperature or below without significant change in properties. Yet many materials such as ceramics, which behave as insulators at room temperature, become semiconductors at

Fairchild Using Process

Vacuum-evaporation process currently is being used by Fairchild Camera & Instrument Corp. to produce precision film potentiometers capable of operating at full rating at temperatures of 225C. Company spokesman says special potentiometers fabricated by the process have operated "near full rating" in 400C ambient for several hundred hours. However, unlike Servomechanisms, Fairchild is not currently applying the vacuum-evaporation process to fabricate other types of components, company spokesman says.

for interchangeable new Heinemann Series 400 ∿ or DC service AM17 Circuit Breaker

Flying with such top-performance aircraft as the Lockheed F-104, Heinemann's new AM17 circuit breaker has demonstrated perfect reliability on both sides of the sonic barrier.

Hydraulic-magnetic operation makes the AM17 a stable performer through widely varying ambient temperature conditions. No de-rating, no compensation for temperature or vibration necessary.

Designed for interchangeable use on 400-cycle or DC service, and produced to military specs, the AM17 may well be the *one* circuit breaker for all your electrical and electronic protection requirements.

Complete specifications, including time-delay characteristics, are given in Bulletin T-3302. Send for a copy.

Single-pole AM17's may be readily ganged in the field for two- and three-pole Companion-Trip® applications.

HEINEMANN

HEINEMANN ELECTRIC COMPANY
105 Plum Street Trenton 2, N. J.

Circuit breakers

elevated temperatures (because electrons in their atomic valence bands move up into the conduction bands).

The trick is to find or develop materials which have built-in temperature compensating mechanisms. For example, by introducing suitable impurities into certain ceramic-type materials, it is possible to obtain a material for high temperature resistors with relatively small temperature coefficient from low temperature up to 500C or beyond, Redemske says. He declines to cite specific materials which look promising, for competitive reasons.

With materials now in hand, it is possible to make vacuum-evaporation resistors capable of operating at 600C. This upper limit may go to 1,000C in the future, Redemske says. These high-temperature resistors should be no larger than their conventional equivalents and can be made in corresponding resistance ranges.

500C Capacitors Made

Major problem in making capacitors for 500C operation is to find materials which retain high dielectric strength and high resistivity at elevated temperatures. Servomechanisms has experimentally fabricated capacitors which operate at 350C and exhibit a resistance-capacitance product of about 1-5 megohm-microfarads, using aluminum oxide dielectric.

Using boron nitride for a dielectric, company has experimentally made capacitors which operate at 500C and have an R-C product of about 10 megohm-microfarads. However, Redemske admits that it is not easy to achieve uniform film deposits with boron nitride.

These 500C capacitors are comparable in size to conventional units in values up to about 0.01 mfd., somewhat larger in higher values. However, improved techniques may make it possible to reduce thickness of deposited metal/ceramic films and thus reduce size.

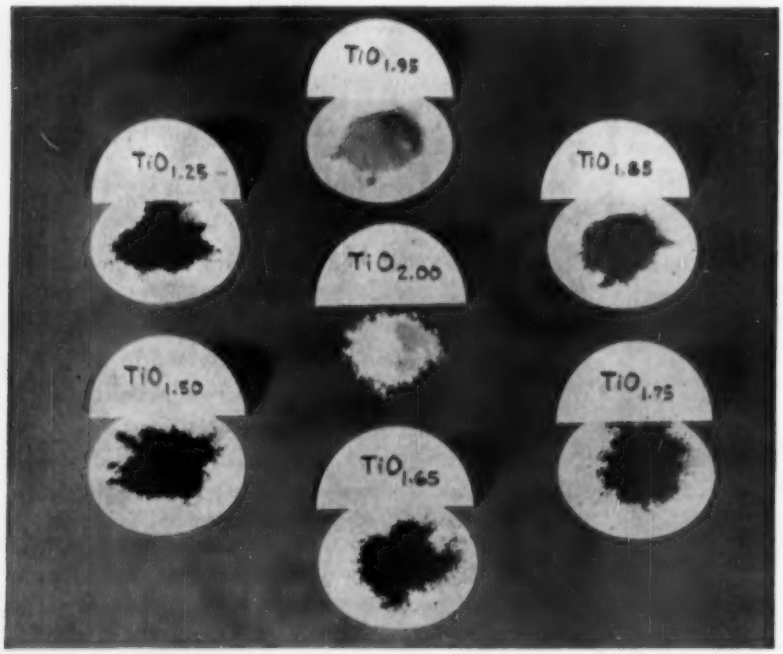
Promising Materials

Servomechanisms research laboratory is actively investigating a class of compounds which have unusual and exciting characteristics for possible high-temperature components. These are ternary compounds, sometimes referred to as Perovskites, consisting of two metal oxides in combination. Barium titanate and lead niobate are typical examples. But the group also includes families of zirconates, tantalates, cerates and aluminates.

One of the Perovskite characteristics of major interest is an extremely high dielectric constant which ranges from 200 to 50,000 times the dielectric constant of boron nitride, Redemske says.

Many of these compounds exhibit piezo-electric and ferro-electric properties. The latter property suggests possibility of making miniaturized ferro-electric flip-flop circuits by the vacuum-evaporation process.

Another type of material, called non-stochiometric compounds, is being investigated for use in making deposited



UNUSUAL FORMS of titanium dioxide, which have been "robbed" of some of their oxygen so they become semiconductors. It is one promising new material being investigated.

Exciting new things are happening at

HOFFMAN ELECTRONICS

Out of advanced electronics research and development at Hoffman comes an entirely new concept in ground radar. Still under wraps by the Military, this unusual and practical Hoffman development applies revolutionary techniques to solving complex weapons systems problems.

Hoffman's extensive experience in designing, developing and producing radar for airborne and shipboard installations laid the groundwork for this exciting new electronics development. In radar, as in other vital military and commercial fields—countermeasures, navigation, weapons and communications systems—Hoffman continues to produce the pattern for progress in electronics.

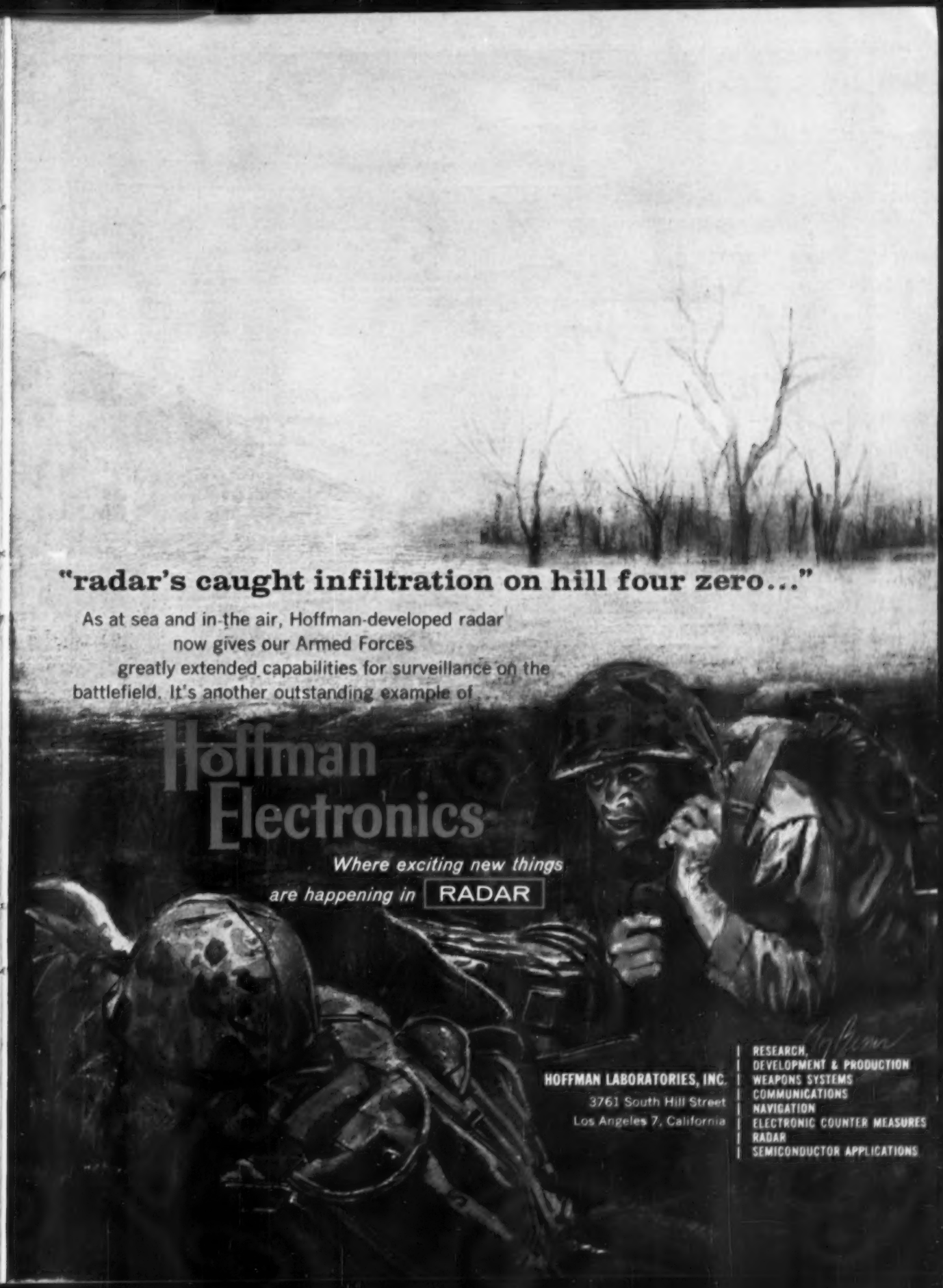
In a dynamic industry where only change is permanent, exciting things continue to happen at Hoffman.

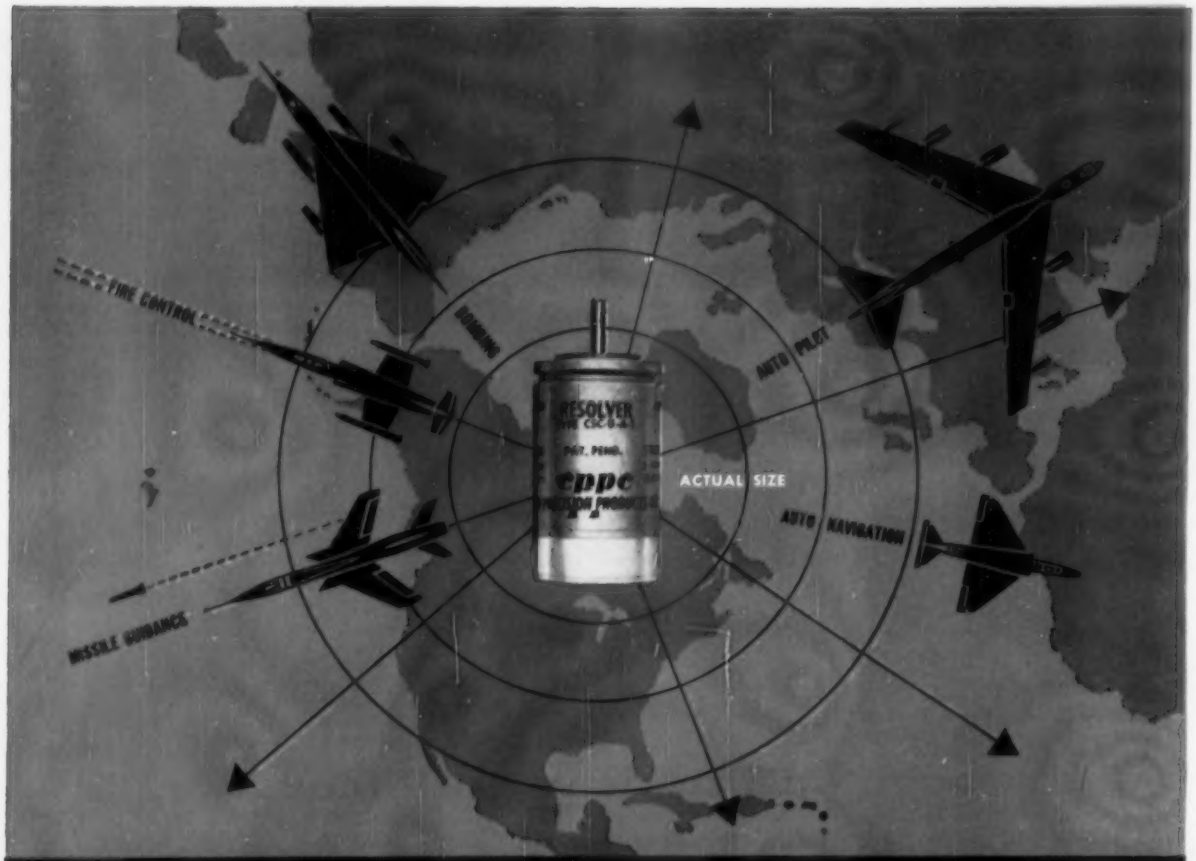
PHYSICISTS • ELECTRONICS AND ELECTRO-MECHANICAL ENGINEERS

Significant new developments at Hoffman in the fields of navigation, VLF, HF, VHF, UHF, radar, ECM, weapons systems and semiconductors have created important positions for scientists and engineers of high calibre. Please address inquiries to Chief Engineer.

Hoffman Electronics

HOFFMAN LABORATORIES, INC.
3761 South Hill Street
Los Angeles 7, California


"radar's caught infiltration on hill four zero..."
As at sea and in the air, Hoffman-developed radar now gives our Armed Forces greatly extended capabilities for surveillance on the battlefield. It's another outstanding example of
Hoffman Electronics
Where exciting new things are happening in RADAR
HOFFMAN LABORATORIES, INC.
3761 South Hill Street
Los Angeles 7, California
RESEARCH,
DEVELOPMENT & PRODUCTION
WEAPONS SYSTEMS
COMMUNICATIONS
NAVIGATION
ELECTRONIC COUNTER MEASURES
RADAR
SEMICONDUCTOR APPLICATIONS



IN AVIONIC EQUIPMENT, WHY LOAD ON EXTRA WEIGHT?

use Clifton Precision Size 8 Synchros

WEIGHT 32 GRAMS

SYNCHRO FUNCTION	CPPC TYPE	ROTOR AS PRIMARY: Input Voltage (400~)	Input Current (Amps.)	Input Power (Watts)	Output Voltage (Volts)	Sensitivity (MV/deg.)	Phase Shift (deg. lead)	STATOR AS PRIMARY: Input Voltage (400~)	Input Current (Amps.)	Input Power (Watts)	Output Voltage (Volts)	Sensitivity (MV/deg.)	Phase Shift (deg. lead)	D.C. RESISTANCE: Rotor (Ohms)	Stator (Ohms)	IMPEDANCE: Zrr (Ohms)	Zss (Ohms)	Zrs (Ohms)	Max. Null Voltage (MV)	Max. Error (Min.)
Torque Transmitter	CGC-8A-7	26	.100	5	11.8	206	8°	—	—	—	—	—	—	37	12	54 + j260	12 + j45	80 + j70	30	7
Control Transmitter	CTC-8A-1	—	—	—	—	—	—	11.8	.090	2	23.5	410	9°	150	24	212 + j684	22 + j115	246 + j60	30	7
Control Transformer	CTC-8A-4	—	—	—	—	—	—	11.8	.029	.08	22.5	390	8°	389	64	560 + j1860	90 + j340	640 + j190	30	7
Torque Receiver	CRC-8A-1	26	.100	5	11.8	206	8°	—	—	—	—	—	—	37	12	54 + j260	12 + j45	80 + j20	30	30 sq.
Electrical Resolver	CSC-8A-1	26	.038	.42	10.8	190	20°	11.8	.078	.26	23.2	400	11°	230	27	286 + j620	45 + j148	350 + j75	30	7
Electrical Resolver	CSC-8A-4	26	.038	.42	26	454	20°	26	.030	.23	21.5	375	12°	230	170	286 + j620	250 + j830	350 + j75	30	7
Control Differential	CDC-8A-1	—	—	—	—	—	—	11.8	.085	.21	11.8	206	9°	36	25	38 + j122	27 + j120	48 + j14	30	7
Vector Resolver	CVC-8A-1	26	.057	.34	11.8	206	10.2°	—	—	—	—	—	—	78	27	103 + j440	8 + j30		30	7

LOOK TO CPPC FOR SYNCHRO PROGRESS

CLIFTON PRECISION PRODUCTS CO. INC. cppc Clifton Heights, Pa.

semiconductors. By undisclosed techniques, company scientists take a compound like titanium dioxide (TiO_2), deliberately "rob" it of some of its oxygen without collapsing the crystal structure. This leaves it with a surplus of electrons in the conduction band, makes it an N-type semiconductor.

Redemske refers to the resulting material as a "sub-dioxide" to denote its missing oxygen, or as $TiO_{1.n}$, although he admits that most chemists will argue that the number of oxygen atoms must be shown as an integer and that decimal subscripts are not found in chemical textbooks.

Company has created a variety of subdioxides of titanium, ranging from $TiO_{1.m}$ to $TiO_{1.99}$ as shown in photo, p. 74.

350C Diode Rectifiers

But the important thing is that the material can be deposited by vacuum-evaporation techniques and that it provides rectifier action at 350C. Titanium sub-dioxide is not the best possible material, but Redemske says Servomechanisms has better ones which he declines to identify. Servomechanisms has not yet investigated carrier injection properties of these materials to determine whether transistor action can be achieved, but this is on the agenda.

Research into high temperature materials has raised some knotty fabrication and measurement problems. For example, to form certain materials into solid pieces for test or vacuum-evaporation process, they must simultaneously be subjected to extremely high temperatures and pressures.

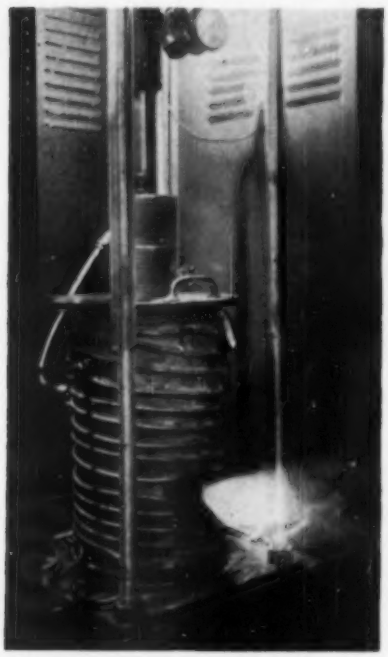
New Hot Press

Lack of suitable furnaces on the market forced Servomechanisms Research Laboratory to develop its own "hot press" which can raise material temperature to 3,600C and simultaneously subject it to compressive force of up to 6,000 psi. Operation can be carried out either in a vacuum or with furnace filled with inert gas at desired pressure.

Laboratory also was forced to design and build its own measurement furnaces for checking critical electrical properties of materials while sample is at elevated temperatures.

As promising new materials are turned up by research, the Vacuum Film Products division takes them over to evaluate their suitability for the vacuum-evaporation process.

WADC contract for development of 500C capacitor calls for device that is also nuclear radiation resistant. Although no radiation tests have yet been run on experimental units, Redemske is hopeful that intentionally distorted crystal structure required to obtain material with high temperature characteristics will tend to make it less vulner-



EXPERIMENTAL hot press, developed by Servomechanisms for research in new materials, can subject them to 3,600C temperature and 6,000 psi. compressive force in a vacuum or inert gas.

INTRODUCING THE

miller GOLD STAR 300 SERIES

GREAT NEW AC-DC ADDITION TO THE MILLER LINE

Here is the finest in inert gas and metallic welding

Complete particulars sent on request

miller ELECTRIC MANUFACTURING CO., INC.
APPLETON, WISCONSIN

distributed in Canada by CANADIAN LIQUID AIR COMPANY, Ltd., Montreal

Beware of the Snark!

The nation's first intercontinental missile . . . the Air Force's Northrop Snark SM-62. Equipped with a nuclear warhead, the Snark is a so-called air-breathing missile which travels in the earth's atmosphere. Its compact design presents a smaller target for radar, interceptors, or anti-aircraft missiles.

Extremely mobile, the Snark can be air lifted to any site within a few hours.

The pilotless bomber is powered by a Pratt-Whitney Aircraft J-57 turbo-jet engine equipped with a Holley compressor bleed governor. It flies in near-sonic speeds above the weather over the longest range yet possible by a missile in the free world today.

Like all Holley engine controls, the compressor bleed governor is dependable, easy to service, compact and lightweight — four vital qualities for aviation equipment.

HOLLEY Carburetor Co.

LEADER IN THE DESIGN, DEVELOPMENT, AND MANUFACTURE OF AVIATION FUEL METERING DEVICES.

11955 E. NINE MILE ROAD, VAN DYKE, MICHIGAN

able to radiation damage. Confirmation must await scheduled tests at the Brookhaven reactor.

Servomechanisms has no target timetable for setting up to supply high temperature components on a production basis—except for its Army Signal Corps potentiometer facility. Redemske does not minimize the amount of materials research that lies ahead, but he says that considerable progress has already been made. It appears reasonable to predict that Servomechanisms may become a source for extremely high temperature components, in a variety of types, within the next five years.

Equally important, Servomechanisms' progress to date can be expected to spur established component manufacturers to investigate the promising vacuum-evaporation process.

Expansions, Changes In Avionics Industry

National-El Ray Co., North Hollywood, Calif., is name of new firm formed by merger of El Ray Motor Co., maker of miniature motors, Valco Engineering Co., maker of ceramic capacitors, and National Electronics Corp., manufacturer of filters, transformers and avionic heating devices. John N. Valianos is president of new firm; plants are located at 11747 and 11845 Vose St.

Other recently announced expansions and changes in the avionics industry:

• **American Machine & Metals, Inc.,** has purchased name and certain assets of Rahm Instruments, Inc., and leased the latter's plant at Westbury, N. Y. New acquisition, to be known as Rahm Instruments division, manufactures electro-mechanical instruments for aircraft and missiles.

• **American Bosch Arma Corp.** has launched $2 million expansion and modernization of the Garden City, N. Y., plant of its Arma division. Plans call for an 8,000 sq. ft. "sterile area" for making inertial guidance components and 22,000 sq. ft. of new assembly facilities.

• **C. P. Clare & Co.,** Chicago, maker of relays and components, will build new $1.25 million, 40,000 sq. ft. plant at Fairview, N. C., where company has been operating for two years in leased quarters. Completion is scheduled for June 1958.

• **Westinghouse Electric Corp.** has completed new 100,000 sq. ft. wing at its Air Arm division plant in Baltimore.

• **Hydel, Inc.,** is name of new automatic control research and development organization formed by 10 former members of the Massachusetts Institute of Technology's Dynamic Analysis and Control Laboratory. New company, which has opened temporary headquarters at 99 First St., Cambridge, Mass., is headed by Emery St. George, Jr. Hydel plans to develop and manufacture new control components and systems as well as provide consulting service to industry.

• **Transval Engineering Corp.,** Culver City, Calif., has licensed **Canadian Applied Research Ltd.,** Toronto, to produce certain of Transval's airborne transistorized power supplies.

Talos Guidance

Powerful AN/SPG-49 radar will provide shipboard guidance for Talos anti-aircraft missile by bouncing radar energy off attacking aircraft. Semi-active guidance system in the missile uses reflected energy to home on target. Sperry Gyroscope Co., which developed the SPG-49, holds more than $47 million in production contracts plus more than $51.5 million for similar AN/SPQ-5 missile guidance radars for the Terrier anti-aircraft missile.

FILTER CENTER

▶ **Communications Slip-Stick**—Variety of communication system problems can be speedily solved and effect of change in parameters evaluated on new Glennite communication system calculator developed by Gulton Industries, Metuchen, N. J. New slide rule, priced at $2.00, takes into account such variables as transmitter power, frequency, receiver bandwidth, input noise figure, input signal level, path loss, antenna gain and total path distance and horizontal ray distance.

▶ **Short Circuit Protection**—Transistorized a.c. to d.c. converters, which suffer no damage from short circuit across load and whose short circuit current drops to about 10% of rated current within about 30 microseconds, have been developed by Transval Engineering Corp., Culver City, Calif. Initial current surge after short circuit reaches about 150% of full load current but lasts only about 15 microseconds, company says.

▶ **RCA and IBM Exchange Patents**—Non-exclusive agreement to exchange licenses on digital computer and data processing machine patents has been signed by Radio Corporation of America and International Business Machines Corp.

▶ **Cause of Failure**—Misapplication of only 5% of the components in avionic equipment produced 55% of the high failure rates, according to post-mortem analysis made by Hughes Aircraft Co. on 5 million sample parts in 18,000 units.

▶ **Calling All Authors**—The 1958 Electronic Components Conference, to be held April 22-24 at Ambassador Hotel, Los Angeles, is seeking technical papers on components, including transistors and tubes and their application, and component reliability. Potential authors should write to E. E. Brewer, Convair, Pomona, Calif., before Nov. 15.

▶ **Keen Competition**—Radio Corporation of America, originally set up as second source producer of Hughes interceptor fire control systems, now is hotly competing with Hughes to get RCA-developed system on medium-range interceptor being developed by North American Aviation. One of RCA's big talking points is the long range of its new airborne radar. At one point several months ago, USAF reportedly was considering possibility of using RCA radar in Hughes fire control system going into F-106.

▶ **Signed and Sealed**—Contract awards recently announced include:

• **Westinghouse Electric** has received $10 million Navy Bureau of Aeronautics contract for production of Aero 21-B radar-directed bomber tail turret systems for use on A3Ds and a $9 million contract from Bureau of Ships for shipboard air-search radars.

• **Avco's Crosley Division** has received Air Force letter contract for continuing production of B-52 radar-directed tail turrets. Initial figure is $1 million, but is expected to reach $10 million by completion of program.

▶ **Traffic Control Studies**—Armour Research Foundation is using digital computer to simulate flow of air traffic in study sponsored by Army Signal Engineering Laboratories and Air Navigation Development Board. Objective is to determine effect of changes in route structure and rules of the control system on air traffic capacity.

Brazed all-metal honeycomb sandwich saves vital pounds in high-speed missiles

HEAT AND STRESS RESISTANT materials are of vital importance in the exciting area of missile technology. Stainless steels and high alloys are the best bet to date for hot-speed applications—but the specific gravities of these materials present a problem. Solar advanced technology has helped solve this problem with all-metal honeycomb sandwiches.

Solite®—a steel and high alloy sandwich structure developed by Solar—is a brazed material of foil-thin ribbons bonded between metal skins. It is lightweight, has remarkable heat resistance at speeds approaching Mach 3 and can withstand pressures that would crumple unstructured metals.

Large new electric furnaces—the only ones of their type—were designed by Solar to braze the sandwich structures. In addition to stainless steel, various high alloys are used for the honeycomb cores, and research in the use of other metals is in progress. For more than a decade Solar has placed special emphasis on guided missile technology—developing new metalworking techniques for the missile age. Solar's versatile missile team is available *now!* For more information write to Missile Engineering, Dept. D-90, Solar Aircraft Company, San Diego 12, California. *Designers, developers and manufacturers of gas turbine engines, expansion joints and aircraft engine, airframe and missile components.*

SOLAR
AIRCRAFT COMPANY
SAN DIEGO
DES MOINES

ENGINEERS WANTED *Unlimited opportunities, challenging projects, good living with Solar! Write for new brochure.*

SMALL ONE-CHANNEL elevated temperature structures test facility used for equipment development by Westinghouse engineers. Left to right are the Berkeley EASE computing console, curve-following console, ignitron power controllers and heat lamps. Drum-type curve follower uses conducting ink on graph to form pickoff for a resistance bar pressed against paper on drum.

Infrared Simulates Aerodynamic Heating

By Robert H. Cushman

Infrared heat lamps that simulate thermal thickets are expected to soon take their place alongside supersonic wind tunnels and stress stands as important development tools for supersonic aircraft and missiles.

Largest sales effort on this new type of facility has been from the aviation section of Westinghouse's Transportation Sales Dept., East Pittsburgh Works, Pittsburgh, Pa., but other companies such as Spar, a small electronic firm in Wyncote, Pa., General Electric Co., the exclusive supplier of the heating lamps, and Research Inc., Minneapolis, Minn., are selling components and are considering offering integrated systems later.

Westinghouse estimates the dollar volume for this particular type of testing equipment to be $2½-5 million over the next year.

Lamps Form Oven

The ETSTFs (elevated temperature structural test facilities) or components thereof being produced by these companies consist of batteries of GE T-3 quartz crystal heat lamps arranged around the tested aircraft or missile frame.

The heat lamps are run at many times above the rated 1,000 watts and in effect form a radiant heat oven which will produce skin temperatures rising at about 150F per second to 2,500F temperature levels.

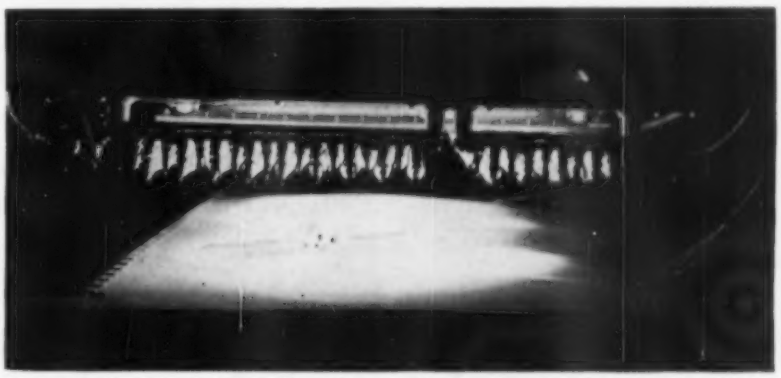
The lamps are divided into groups which are spotted over the test part proportionally to the expected aerodynamic heating which has been either calculated or deduced from various flight tests.

Each of the lamp groups in turn is hooked into its own control channel and programmed to follow a curve which represents the heating variation of that section over the duration of a particular flight mission.

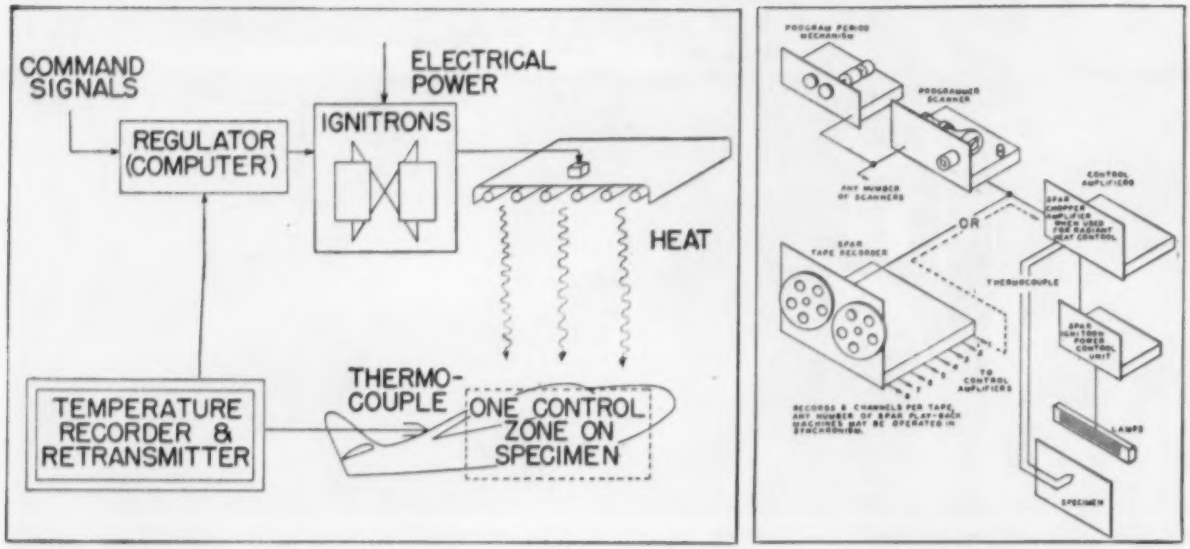
The purpose is to find out under controlled conditions just how the aerodynamic heat from the skin flows in through frames and fuel tanks, etc., to the interior of the vehicle. It is important to know this because the rapid heat flow in a high-speed missile may cause such unexpected catastrophies as buckling of the load-carrying members due to unbalanced thermal expansion, erratic or unstable flight due to thermal warping of the flight surfaces or failure of internal electronic and propulsion components due to overly rapid heat flow.

Manufacturers Interested

At present ETSTF installations are limited, but interest from nearly all the major airframe companies indicate that installations will be built up rapidly. Among those who either have temperature simulating equipment or who are interested in purchasing this type of equipment are: Chrysler Corp.'s Missile Division, Boeing Airplane Co., Lockheed Aircraft Corp., North American Aviation, Inc., Republic Aviation Corp., Convair, Bell Aircraft Corp., the Martin Co.'s Denver division, the Army's



CLOSEUP of quartz-crystal heat lamps directed down on portion of aircraft wing in Spar experimental run. Small spots on skin are for thermocouple leads; in actual tests high temperature strain gages would be used too. For picture of actual thermal test being run by North American Aviation see AW Jan. 21, page 67.



SCHEMATIC of Westinghouse ETSTF (left) and diagram of Spar circuit (right). While Westinghouse uses a drum-type programmer developed by members of Redstone Arsenal, Spar uses either a partially blanked-off cathode ray tube or signals from tape. Spar believes that a pulse-width modulated system using tape input will provide the most compact, flexible method of programming the temperature and aerodynamic loads for different trajectories.

Redstone Arsenal at Huntsville, Ala.

Two of the most elaborate facilities in existence are at the Navy's Aeronautical Structures Laboratory, Philadelphia, and at USAF's Structures Laboratory, Wright Aeronautical Development Center, Dayton, Ohio.

The original portion of the USN equipment consists of 4,000 kva. divided into 40 channels of 100 kva. each.

Navy Equipment

Each channel is controlled by a saturable core reactor (magnetic amplifiers) programmed by a Spar cathode ray tube curve follower. Temperature feedback from a thermocouple on the test specimen is used to keep the test model's skin temperature close to the program curve.

The Navy is now in the process of adding another 4,000 kva. The additional power will be composed of 12 channels of 350 kva. each in which faster response rate ignitron electronic power controls by Westinghouse will be substituted for the saturable core reactors. With the 8,000 kva. the laboratory expects to be able to cover 1,200 sq. ft. model surface. The laboratory's present test work is directed toward finding out how structure frequency changes with heating rates for the prediction of high speed flutter phenomena.

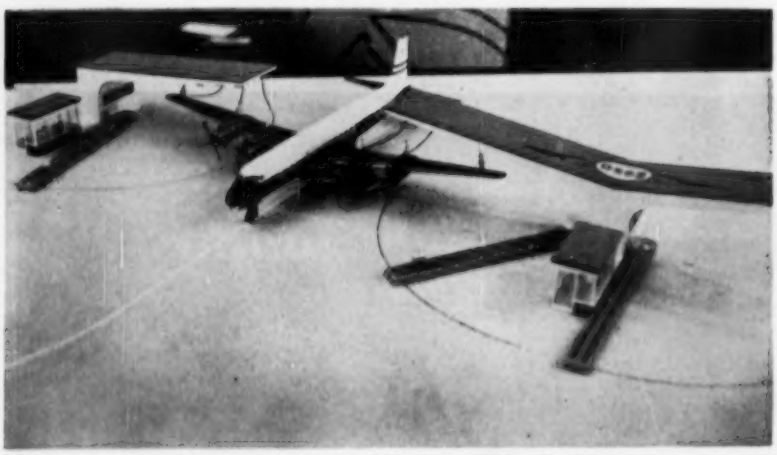
The USAF WADC set-up was originally developed from saturable core reactors controlled by programmers made by Research, Inc. However the time lags inherent in saturable core reactors have caused stability problems during rapid thermal accelerations and USAF has reportedly become interested in Westinghouse ignitron tube control.

The significant difference between the WADC and USN installations, though, is that while the USAF facility attempts to base its test upon the amount of heat transferred, the USN facility settles for skin temperature as the test reference. While admitting that the Wright Field approach is theoretically the ideal one, the Navy laboratory believes that for the time being the more measurable quantity of skin temperature ought to be used.

Drawbacks Experienced

Each has its troubles. The trouble with using skin temperature is that it is difficult to calculate. Unless you have made actual flight test measurements on a missile or airframe of similar type, you are never sure of the accuracy of the starting point of your simulation.

The difficulty of using heat transferred starts with the feedback end. Since there is no known instrument which will directly measure the heat transferred to the test item, you must use such indirect means as either measuring the power you put into the lamps or introduce a computing element to take the derivative of the skin temperature if the skin is sufficiently "thermally thin." In this more complicated



Model Refueling Dock

Model of proposed Esso airport refueling station shows cantilevered arms carrying fuel lines to DC-7C for simultaneous refueling. Cost is estimated at 50-60% of initial cost of conventional stations. Esso says Boeing 707 could be fully fueled in about 17 minutes.

approach you also have to manufacture the desired rate of thermal energy input. This is done by a computing element which solves the equation of heat transfer coefficient times the temperature difference between the boundary layer and the skin.

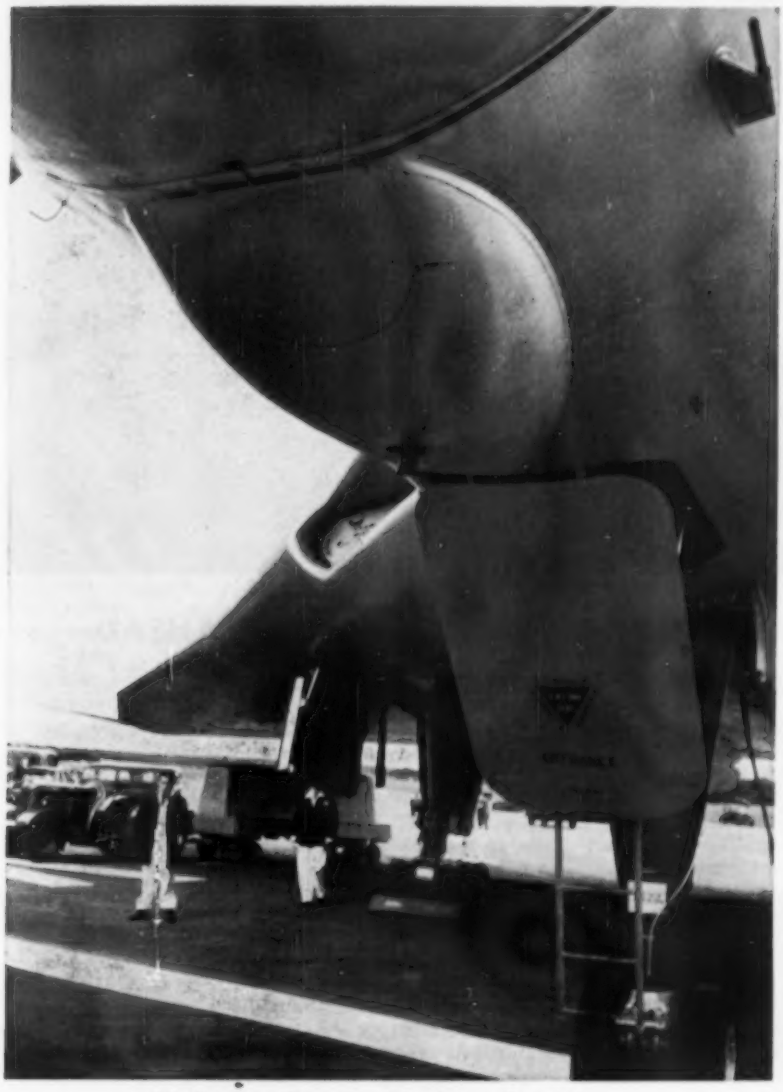
Inadequate Facilities

A source of error which is to varying degrees common to both systems is the present uncertainty about the exact nature of the heat transfer in the boundary layer.

Compared to ETSTF needs, workers in this field feel that most other existing facilities are both crude and limited in capacity. In general, surveys show that the missile developers want faster responses and higher maximum heat levels and that the airframe developers mainly want larger capacity. Thus, while airframe manufacturers appear to be satisfied with equipment which would produce 500-600F skin temperatures (Mach 3.0) at up to 15 minute durations, missile manufacturers want heating rates and temperatures as high as 5,000F in 20 seconds, according to Spar.

Heat Flow Rates

According to Westinghouse, heat flow rates would be up to 10 kw. per sq. ft. for airframes and up to 100 kw. per sq. ftm. for missiles. For the



Vulcan Bomb-Aiming Position

Avro Vulcan B. 1, now starting squadron service in one group of Bomber Command, has visual bomb-aiming position—with window blanked over—below crew compartment. Door behind is crew entrance, also exit for downward ejection seat.

THERE'S A NEW KIND OF MANNED AIRCRAFT AHEAD

No machine will ever duplicate man's unique ability to meet an emergency or to make the most of an opportunity. That is why the air crew team is still the decisive factor in our nation's defense—and may always be so.

America's strategic missiles are being brought to reality in an all-out effort by the military and industry. They will be potent additions to the nation's arsenal.

But for *maximum* security in the years ahead America also needs *manned* aircraft whose performance will be as advanced as that now being developed in missiles. The combination of man's judgment and higher-performance planes may always be our most versatile, flexible, and accurate weapon.

These new aircraft will fly so fast, so high, so far that they will be forerunners of manned spacecraft. They'll be able to bomb any target on earth with pinpoint precision—or to launch the warhead stage of a missile from the edge of Space. And their advanced automatic electronic control systems will free the pilot for what only he can do: make command decisions.

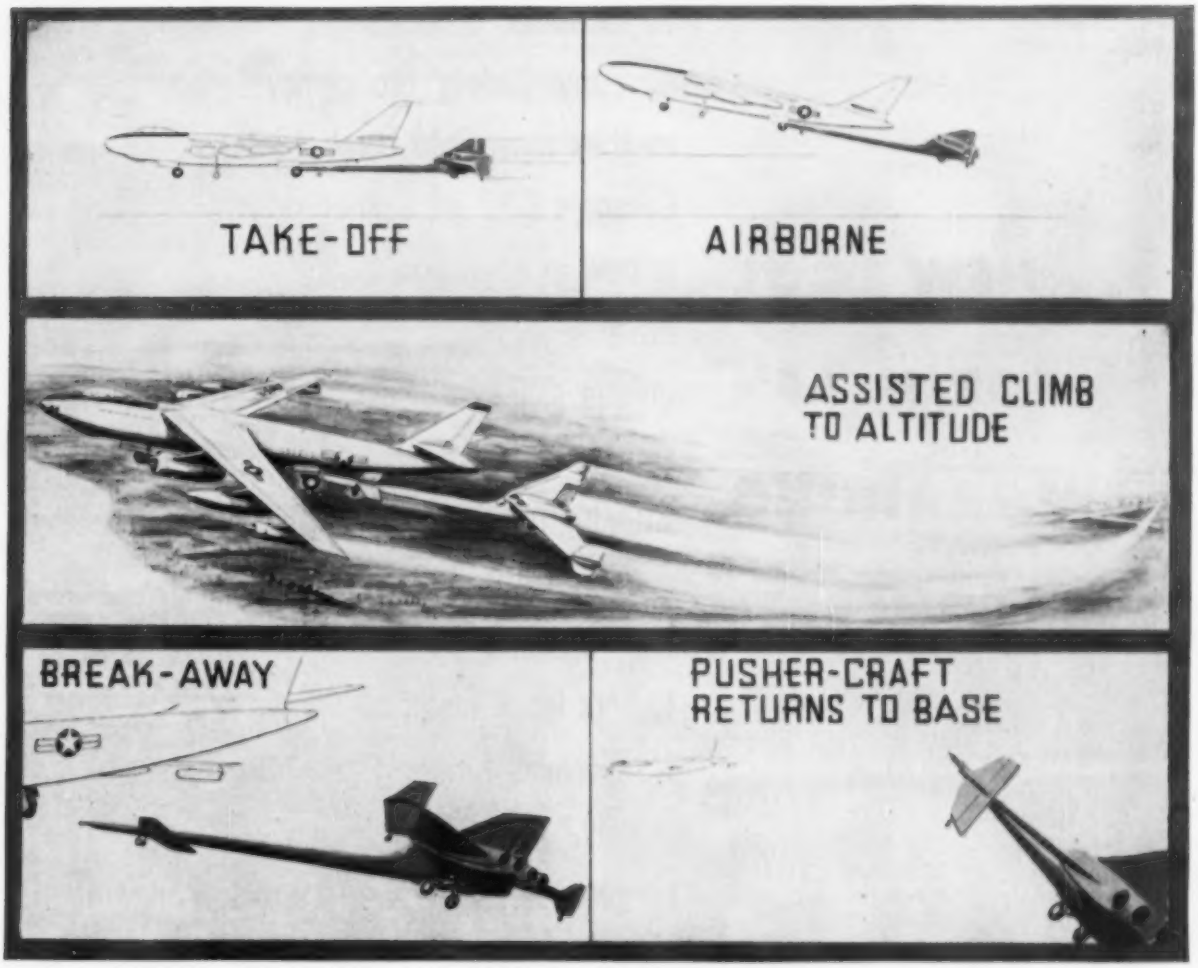
Such aircraft are now in development at North American. Exhaustive studies are being made into every aspect of the strategic bomber of the future. To this task North American brings the greatest store of supersonic experience in the Free World. North American has built more supersonic aircraft than all other companies combined. These studies, in collaboration with the U.S. Air Force, have already resulted in a unique design concept for Weapon System 110, an incredibly fast upper-altitude manned chemical bomber with global range.

Another outgrowth of North American's supersonic experience is the X-15, a rocket-powered research plane that will fly man faster and higher than he has ever flown before.

Again and again, North American has demonstrated its ability to translate ideal performance into wing-strength production—accurately, rapidly, and at lowest possible cost.

NORTH AMERICAN AVIATION, INC.

Los Angeles, Canoga Park, Downey, California; Columbus, Ohio; Neosho, Missouri



Bomber-Pusher

This All American Engineering concept envisions a four-jet, canard configuration, piloted airplane with fixed landing gear to push heavy bombers during takeoff to shorten takeoff run and help during initial climb-out. Cockpit is a juncture of fin leading edge and fuselage. After bomber has reached a predetermined altitude, pusher plane slows up, detaches its probe from the bomber and returns to base for the next ship. Illustrations show how concept would work with a plane pushing a B-47 at rear main landing gear.

immediate future, Westinghouse does not believe temperature requirements will go above 2,500F (roughly Mach 15).

Westinghouse quotes $25-50 per kw. while Spar talks in terms of $3,000-$4,000 per each 100 kw. channel. A facility to test a complete B-58 might cost $½ million.

Problems Exist

Before enlarged facilities can be built and put to profitable use a number of problems must be solved. The first is the previously mentioned matter of unraveling the phenomenon underlying the transfer of heat in the boundary layer so that more precise heating programs may be fed into the tests.

Then there are several more practical problems which exist down on the testing level.

One problem is that of perfecting a heat-resistant paint or coating for the test model so that it will efficiently absorb nearly all the infra-red energy directed at it.

Saureisen cement and graphite in lacquer have been utilized but tend to lose their blackness after repeated heatings.

Another is that of how to simultaneously apply mechanical loads without disrupting the IR radiation.

At the present time the Navy is using high-rateloaders which apply the various loads by means of rods and are also time-programmed through the entire test.

Applying Loads

For the future the test engineers are considering using small rockets to apply sudden loads (for example, due to a sudden turn command) and loads applied by electro-magnetic fields.

But one of the most forbidding problems, at least for the smaller companies, is the problem of a power source for the large, relatively short, bursts of electrical energy which are typical of missile testing.

Some of the present power controls further aggravate the situation by pulling a lopsided load power factorwise.

Power Expensive

In a recent study, the Navy Structures Laboratory in Philadelphia discovered that it would cost in excess of a million dollars to have the Philadelphia power company put in the additional lines for another 12,000 kva. of power to bring their total to 16,000 kva.

Further, the nature of their load would cause a premium of $1/2 million annually for power used, even though

NEW TOOL FOR USAF's NEW TRAINING CONCEPT!

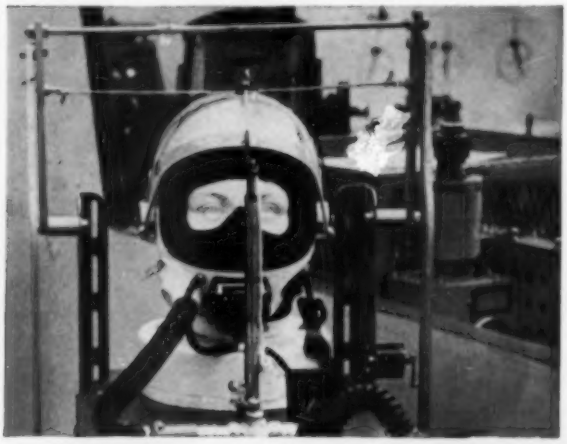
To increase
Air Force Cadets' proficiency
as they move into combat jets,
Cessna's T-37 jet trainer
is now in operation.
Advantages:
unique side-by-side seating,
slow landings
with high speeds
and high-altitude performance,
easy handling.
Cadets learn faster,
USAF saves time,
money.

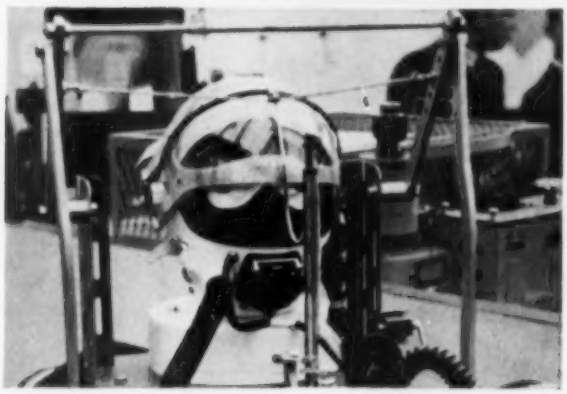
CESSNA AIRCRAFT CO., WICHITA, KANS.

Cessna

they might not use full load over five hours per year.

Obviously this could be a restraining factor, especially for the Philadelphia laboratory, which has entertained plans of going up to the 30,000 kva. needed to test a whole aircraft in ten years. Various alternate power schemes for the ETSTF are now under consideration. One of the most promising is to invest in $1 million worth of storage batteries which can be recharged at leisure. The d.c. output of the batteries would be controlled by a special electronic system now under development.





TWO NEW pressure helmets developed by British companies are Taylor helmet (left) and G. Q. Parachute Company's unit (right).

Helmet Visor Worn Up in Normal Flight

Highlight of the Taylor pressure helmet is that face visor is normally open, eliminating possibility of fogging and giving pilot a sense of freedom. If cabin pressure fails, visor is lowered and locked into position by the same pressure-sensing system that operates pilot's pressure suit. Thus pilot can be free of the visor as long as cabin pressure remains normal.

Three-photo sequence (top to bottom) shows how visor is lowered to protect pilot in case of cabin pressure loss. Other features of helmet include hatch at center bottom for in-flight feeding, quick release and crash protection. Helmet was developed in cooperation with Royal Air Force and Institute of Aviation Medicine, Royal Aircraft Establishment, Farnborough.

G.Q. Parachute Company's pressure helmet, with sun visor, is shown on dummy garbed in complete high altitude flying gear (upper right). G.Q.'s pressure helmet alone (lower right) was also developed in collaboration with the Institute of Aviation Medicine. Sign referring to Canberra's altitude record is misleading since crew wore different type of helmet on that flight.

SUNDSTRAND

First in Constant Speed Drives

Boeing's B-52 for SAC to be equipped with

SUNDSTRAND DRIVES

The Strategic Air Command's Boeing B-52's are now scheduled to be equipped with Sundstrand Constant Speed Drives. Four Sundstrand Drives will provide—under all conditions—the precise frequency control and accurate load division that is mandatory in an automatic, paralleled, 400-cycle electrical system. In addition to their inherent reliability, Sundstrand Drives will contribute to improved aircraft performance because of lighter weight and higher efficiency. Application of Sundstrand Drives on the Stratofortress gives further evidence of the record of reliability and performance that keeps Sundstrand *first* in constant speed drives.

ONE OF MANY MODELS

The "Package-Type" drive, at right, gives the close frequency control to the automatically paralleled alternators in the B-52. Package drives can be adapted to use either independent oil system or engine lube oil system. Other Sundstrand Drives can be custom-engineered to fit your space, weight, mounting, and KVA requirements.

SUNDSTRAND AVIATION

DIVISION OF SUNDSTRAND MACHINE TOOL COMPANY • ROCKFORD, ILLINOIS

Sundstrand-Denver: Denver, Colorado • Western District Office: Hawthorne, California

CONSTANT SPEED DRIVES • AIRCRAFT ACCESSORIES

The Aero 13 fighter armament control system as installed in a U. S. Navy F4D fleet interceptor.

ACTUAL SIZE

The KLIXON M-1 Thermostat, a miniature, hermetically sealed control which limits temperature in the Aero 13 compartment.

"KLIXON THERMOSTAT More Than Meets Requirements"

. . . in WESTINGHOUSE Fighter Armament Control System

A miniature KLIXON M-1 Thermostat plays a vital role in the effective operation of the Aero 13 fighter armament control system developed by Westinghouse for U. S. Navy use. This KLIXON Thermostat, which conforms with military specifications MIL-E-5272A and MIL-T-5574A, limits temperature in the pressurized compartment of fighter planes in which the Aero 13 system is installed.

Westinghouse has elaborate programs of quality control, test, and inspection at the Air Arm Division to make certain that the highest standards possible are maintained.

Their tests show that the KLIXON M-1 Thermostat meets the requirements in its particular application in the Aero 13 fighter armament control system which is manufactured by Westinghouse for the U. S. Navy.

You can count on good performance from KLIXON controls in critical aircraft and guided missile applications.

Write now for special catalog of precision thermostats.

METALS & CONTROLS CORPORATION

Spencer Thermostat Division 2809 Forest Street, Attleboro, Mass.

KLIXON

MULTI-FACETED runway reflector contains 7,500 reflective prisms.

Low Cost Reflector Aids Landing, Taxiing

Highly reflective, inexpensive plastic runway reflector for airports with unlighted landing strips has been developed by Dynamic Specialties, Inc., Birmingham, Mich. There are over 5,500 unlighted airports in the U. S., according to Civil Aeronautics Administration figures. The three-inch units can also serve as taxiway guidance reflectors for larger, lighted airports.

Dynamic Specialties says 200 reflectors have been ordered for taxi strip use at Chicago's Midway Airport; a permanent installation will be made at Birmingham's Berz Field.

Reflector is made of Plexiglas. Its 12 sides each have three facets placed at different angles to pick up maximum illumination from plane's landing lights. Each unit contains 7,500 separate prisms placed 360 deg. around reflector. Reflective facet placement allows reflector to be seen from any point of the compass and from almost any height or approach angle. This allows pilot to use the reflectors to locate a runway from the air, then circle and use units as guidance for landing.

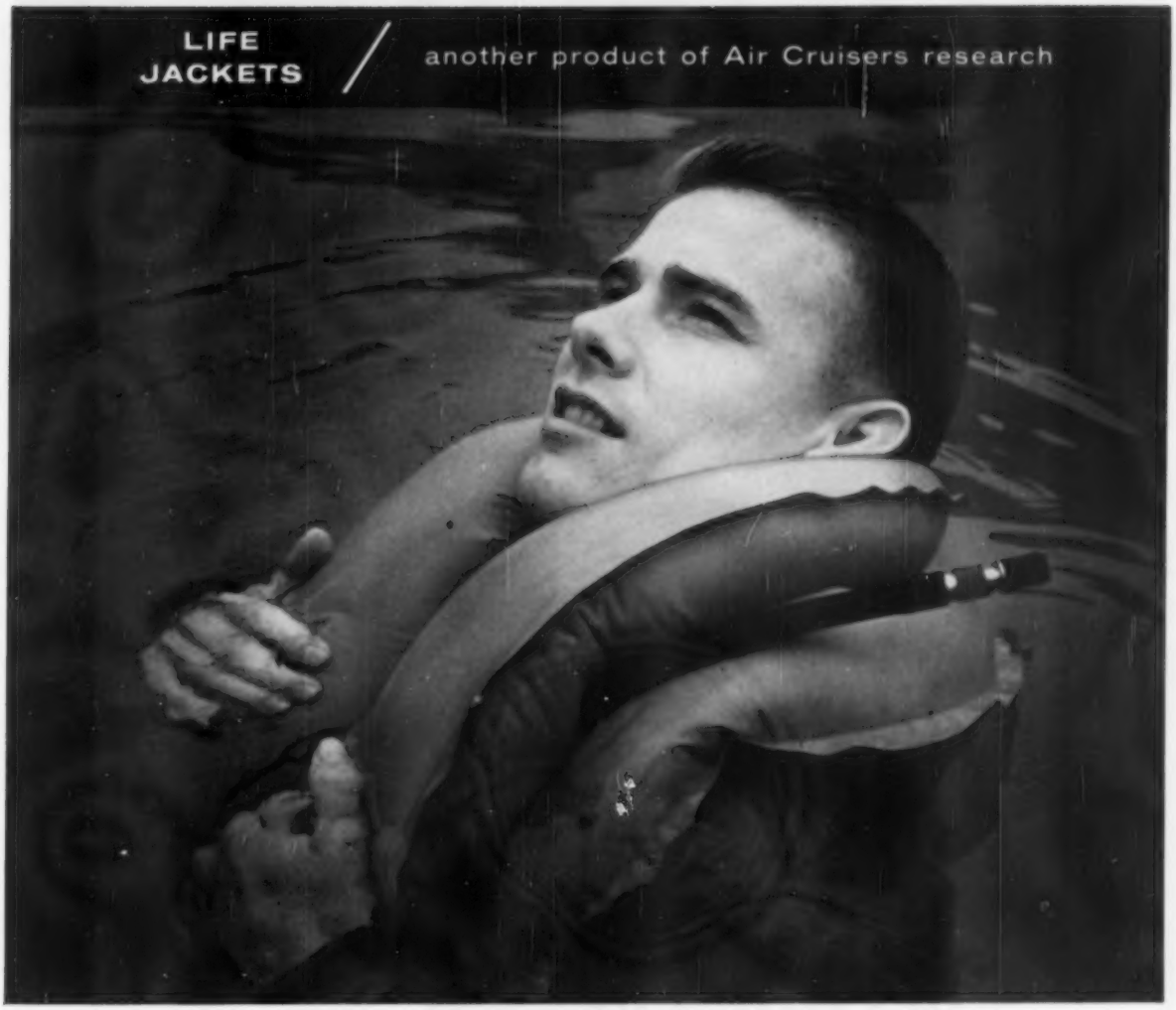
Manufacturer says most effective spacing is 50 ft. apart at approach end of runway, gradually spreading to 100 ft. Units, which are virtually weatherproof, are supported by lightweight metal rods stuck in ground.

Reflectors, strung on ropes or mounted on buoys, could be useful in marking seadromes, according to the maker. They can also be mounted on wind arrows for night visibility.

Units can be supplied in clear (which is the most brilliant), amber, red or green. Larger six-inch model will be available in about two months.

Current three-inch size sells for $1.98. In quantities of 200 or more, cost is slightly less than $1 each.

LIFE JACKETS / another product of Air Cruisers research



Would you bet YOUR life on it?

Every Air Cruisers engineer has been asked this question 1,001 times. Simply because the lives of others often do depend on his work.

Take the life jacket pictured here as an example. It keeps the disaster victim—even an unconscious victim—in proper breathing position.

This "heads up" life jacket is a result of Air Cruisers' continuous research in survival problems. It was made available to the aviation industry and the military only when the answer to that familiar question became "yes."

In recent years, almost every significant development in lightweight survival products has come from Air Cruisers.

Now we are applying the careful design and production policies which achieved leadership in the rubberized fabric field to the manufacture of lightweight industrial plastics and radiation shielding.

And we're making them as though our lives depended on it.

THE GARRETT CORPORATION

AIR CRUISERS DIVISION

BELMAR, NEW JERSEY

LIFE JACKETS • LIFE RAFTS • HELICOPTER FLOATS • ESCAPE SLIDES • PACTON INDUSTRIAL PLASTICS • RADIATION SHIELDING

SEEING EYE

Infrared systems research at Perkin-Elmer helps provide "super-sight" for military aircraft

In modern military aircraft the art of seeing requires a specialized science. Its name is infrared.

Infrared systems were born of the limitations which altitude, darkness and signal jamming placed on conventional reconnaissance devices. Today, infrared systems for reconnaissance and offensive-defensive detection are becoming standard equipment on our latest aircraft. Perkin-Elmer has pioneered in the infrared and optical research which has made these systems possible.

Perkin-Elmer is maintaining its long leadership in the design and manufacture of the majority of infrared analytical instruments in use today.

Its design and production know-how have commanded respect throughout the world. For the military, Perkin-Elmer is actively engaged in the development of new infrared systems. Some of the results that have been achieved may be seen in a special film available for showing to persons who can establish proper clearance and need to know. For information, please write us at 770 Main Avenue, Norwalk, Conn.

Lightweight nitrogen cryostats, airborne and laboratory models, designed by Perkin-Elmer, cool infrared detector heads down to −196°C., greatly increase detector sensitivity.

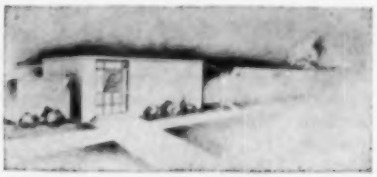
ENGINEERING AND OPTICAL DIVISION

Perkin-Elmer *Corporation*

NORWALK, CONNECTICUT

OFF THE LINE

Calidyne Co. of Winchester, Mass. is building $1½-million, 46,000 sq. ft. plant under an expansion program. Fa-



cility, which will be completed in early 1958, is in Woburn, Mass., near Boston. Calidyne makes electrodynamic vibration test equipment.

Seats for Lockheed's turboprop Electra will be manufactured by Hardman Tool & Engineering Co. under Lockheed specifications. Seats will include luxury chairs, sleeperette and high density types. Hardman is already in production on special lounge seating for the Electra.

Paper-backed volume containing about 30 papers on X-ray diffraction, spectrography, and instrumentation will be available about mid-November at $4.50 per copy. Volume contains the proceedings of the Sixth Annual Conference on Industrial Applications of X-Ray Analysis held by the Denver Research Institute, University of Denver, Denver 10, Colo.

Fusible silicone rubber tapes available from the Silicones division, Union Carbide Corp. Tapes, which become sticky only under pressure, represent a complete departure from usual silicone rubbers which are noted for their non-sticking properties. Feature of the tapes is their resistance to loss of hardness under heat. Tape applications include cable wrapping for electronic equipment on aircraft and submarines. Address: 30 E. 42nd Street, New York 17, N. Y.

First commercial unit of the Cole-Vac airfield vacuum cleaner has been delivered to Boeing Airplane Co. by Coleman Engineering Co., Inc. Fruehauf Trailer Co., which will handle Cole-Vac manufacturing and sales, is currently bidding on 23 service test units of the machine for the Air Force and Navy.

Engine test cell, capable of handling Rolls-Royce RDa. 1 and RDa. 8 Dart turboprop engines, is being built by Continental Air Lines near Stapleton Airfield, Denver. Installation will cost about $250,000. CAL is getting 15 Vickers Super Viscounts, starting March 1958.

Engineers and Scientists:

SHOULD YOU SWITCH TO ROCKET SCIENCE NOW?

Let RMI's Self-Evaluating test help you make your decision . . .

in your own home.

Determine for yourself—immediately—whether your training in your present position qualifies you for the vast opportunities in rocket science. Reaction Motors, America's first rocket engine company, has prepared a technical test for men with three to five years professional engineering experience. You can take this test at home . . . and evaluate the results for yourself.

Send for the test that applies to your particular field of engineering, physics or chemistry. The problems are typical of the kind rocket scientists work with every day. Take the test at your leisure, and score it with the answer sheet provided.

If you score well in the test, you may be ready right now to take your place at RMI in America's fastest-growing industry . . . to work creatively in an exciting new field . . . to enjoy high pay and unusual opportunities for advancement and professional recognition.

Fill out and send in the coupon below for your copy of RMI's Technical Test.

REACTION MOTORS, INC.
60 Ford Road, Denville, N.J.

Please send me your Self-Evaluating Technical Test for Success Potential in Rocket Science.

My Name_____

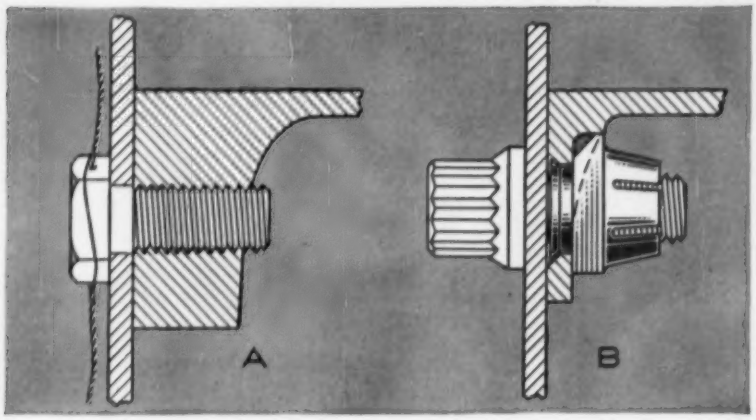
My Address_____

Please check your field.

- ☐ Mechanical Engineering
- ☐ Electrical Engineering
- ☐ Chemical Engineering
- ☐ Civil Engineering
- ☐ Aeronautical Engineering
- ☐ Industrial Engineering
- ☐ Physics
- ☐ Chemistry

RMI REACTION MOTORS, INC.

FASTENER PROBLEM



Self-positioning blind fastener for jet engine flange assemblies

There have been two commonly used methods for fastening flange-type assemblies on jet engines—for such applications as attaching compressor to rotor sections; stator diaphragms to case sections; and securing air seals. The most common design practice has been to use a flange structure thick enough to provide tapped bolt holes with sufficient metal thread length to carry the design load. (Illustration "A") Method number two was to use a thinner flange section supplemented by reinforcing metal "tapping" strip with threaded bolt holes. In both cases the flange assembly carried a heavy weight penalty, and extra labor and material costs were involved in the installation of the locking devices or extra assemblies.

Solution: Such applications have become even more critical with the development of engine designs which eliminate the main rotor shaft by consecutively fastening each compressor stage to its neighbor. The need for a dependable time-and-weight-saving "blind" fastener is met by *ESNA's Type ZL2440* self-wrenching locknut. The shank on this Elastic Stop® nut is permanently flared into place on the bolting flange. The part is prevented from turning by an eccentric lug on the nut which bears against a shoulder on the flange. (Illustration "B")

Type ZL2440 is manufactured from A286 alloy stainless steel to guarantee exceptional tensile performance at elevated temperatures. The ESNA longbeam locking device assures dependable, tested, self-locking performance at elevated temperatures. This new fastening method provides *major weight savings* through flange redesign: it also results in assembly time savings and lower costs.

MAIL OUR COUPON for design information on the ZL2440 nut and other ESNA self-locking fasteners.

Dept. N6-425, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

ESNA

Please send me the following free fastening information:

☐ Standard Drawing of Type ZL2440

☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name_____ Title_____

Firm_____

Street_____

City_____ Zone____ State_____

WHAT'S NEW

Publications Received:

Thermal Stresses—by B. E. Gatewood—Pub. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. $14.00; 458 pp.

This publication covers all phases of the design problem at elevated temperatures. Special applications are given to airplanes, missiles, turbine and nuclear reactors.

Fasteners Handbook—by Julius Soled, P. E.—Pub. Rienhold Publishing Corp., 430 Park Avenue, New York 22, N. Y. $12.50; 657 pp.

Pertinent data, illustrations and full page descriptions supply you with detailed information on currently available fasteners.

Physical and Thermodynamic Properties of Titanium Compounds—Pub. The Office of Naval Research; Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. $2.00; 448 pp.

This book brings together in one place the existing thermodynamic and physical data on compounds of current or potential interest to the extractive metallurgy of titanium.

Aircraft Hydraulic Design—by George Keller—Pub. Applied Hydraulics Magazine, The Industrial Publishing Corporation, 812 Huron Road, Cleveland 15, Ohio. $3.50.

The first book dealing with hydraulic component and system design for high-speed, piloted aircraft and missiles.

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

Tantalum Determination—by R. W. Moshier and J. E. Schwarberg, Wright Air Development Center, U. S. Force: $1.00; 39 pp.; (PB 121819).

Development of Lean-Alloy Chromium-Nickel Stainless Steels for High Temperature Use—by Cornell Aeronautical Laboratory, Inc., for Bureau of Aeronautics, U. S. Navy: $2.25; 86 pp.; (PB 121026).

Temper Brittleness of Boron-Treated Steel—by S. J. Rosenberg, National Bureau of Standards for Wright Air Development Center, U. S. Air Force: $1.75; 66 pp.; (PB 121889).

Development of Cast Iron-Base Alloys of Austenitic Type for High Resistance

and Scale-Resistance—by F. Eberle, J. H. Hoke and W. E. Lyda, Babcock and Wilcox Co. Research Center for Wright Air Development Center, U. S. Air Force: $2.50; 99 pp.; (PB 121950).

Summary of Joint FIL-TDC Simulation Activities in Air Traffic Control—by S. M. Berkowitz, E. L. Fritz and R. S. Miller, Franklin Institute Laboratories for Research and Development and Technical Development Center, Civil Aeronautics Administration: $1.00; 32 pp.; (PB 121919).

Comparison of Four Methods of Encoding Elevation Information with Complex Line-Inclination Symbols—by D. B. Learner and E. A. Allusi, Ohio State University and OSU Research Foundation for Wright Air Development Center, U. S. Air Force: $.75; 27 pp.; (PB 131001).

The Effect of Various Heat Treatment Cycles Upon the Mechanical Properties of Titanium Alloys with Various Interstitial Levels—by B. F. Hadley, G. W. Bauer and D. Evers, Mallory-Sharon Titanium Corp. for Wright Air Development Center, U. S. Air Force: $5.50; 220 pp.; (PB 131009).

The Effect of Microstructural Variables and Interstitial Elements on the Fatigue Behavior of Titanium and Commercial Titanium Alloys—by C. B. Dittmar, G. W. Bauer and D. Evers, Mallory-Sharon Titanium Corp. for Wright Air Development Center, U. S. Air Force: $2.50; 96 pp.; (PB 121972).

Research on Elevated Temperature Resistant Ceramic Structural Adhesives—by H. G. Lefort, R. M. Spriggs and D. G. Bennett, University of Illinois for Wright Air Development Center, U. S. Air Force: $2.00; 74 pp.; (PB 121941).

Atomic Energy Commission Studies on Health and Safety: AECU-3488 Worldwide Effects of Atomic Weapons, Project Sunshine, Aug. 1953: $.55; 104 pp. **ANL-5684 Environmental Radioactivity at Argonne National Laboratory, Report for the Year 1955, Feb. 1957**: $.25; 29 pp.

ANL-5684 Gloves for Protective Enclosures, May 1957: $.25; 22 pp.

NYO-4714 Radiation Protection Within a Standard Housing Structure, Nov. 1956: $.15; 10 pp.

ORNL-2304 A Study of the Distribution and Excretion of Uranium in Man, an Interim Report, n. d.: $.40; 58 pp.

WT-1218 Evaluation of Various Types of Personnel Shelters Exposed to an Atomic Explosion, Operation Teapot,

Strong Adhesive

New adhesive for bonding polyethylene to brass or natural rubber and some synthetic rubbers, which can withstand forces of 1,000 psi., has been developed by Bell Telephone Laboratories. New adhesive is a synthetic known as "partly hydrogenated polybutadiene." Bonding is accomplished by applying adhesive in two or three mil thickness, then applying pressure of 100 psi. or less at temperature of 250 to 350F.

The Men Who Are Air France

No. 6 OF A SERIES

CAPTAIN ANDRE LESIEUR

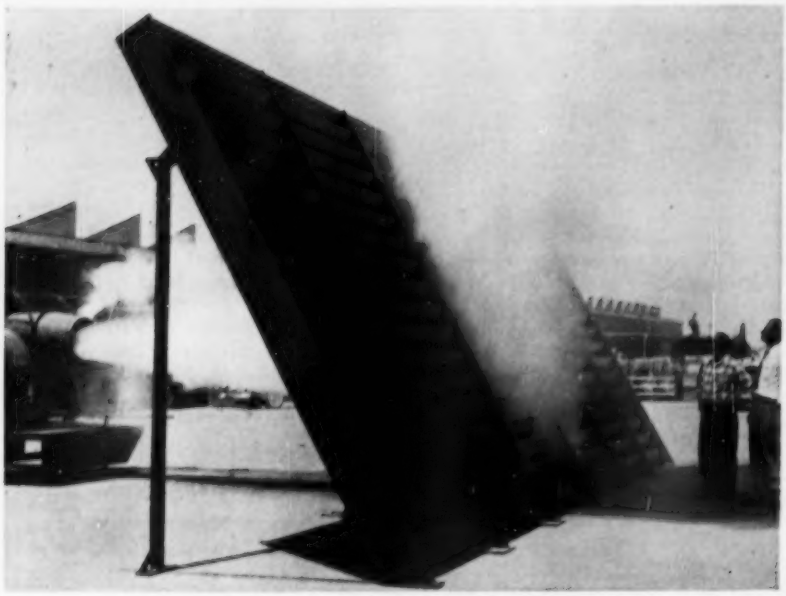
PILOT WITH A PAST—
AND A FUTURE

Captain Lesieur's past 10,000 hours of flight figure importantly in the future of Air France. His experience flying Super Constellations over the Atlantic (120 crossings) will smooth the integration of the new Lockheed Super Starliner into the Air France fleet. His hours at the controls of Comets and Caravelles will be indispensable in the coming changeover to jets. His well-rounded operational background is typical of the men of Air France. It is men like Captain Lesieur who will make it possible to carry on Air France's record of dependable service to the peoples of 73 countries in the generation ahead.

AIR FRANCE

THE WORLD'S LARGEST AIRLINE
WITH 177,740 UNDUPLICATED ROUTE MILES
TO 236 CITIES IN 73 COUNTRIES

SEE YOUR TRAVEL AGENT, OR AIR FRANCE • NEW YORK
ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS
DETROIT • LOS ANGELES • MIAMI • MILWAUKEE
PHILADELPHIA • PITTSBURGH • ST. LOUIS • SAN FRANCISCO
WASHINGTON, D.C. • MEXICO CITY • MONTREAL • TORONTO
VANCOUVER • HAVANA • PUERTO RICO • FORT DE FRANCE
POINTE A PITRE • PANAMA • CARACAS • BOGOTA

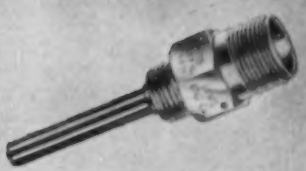


Jet Deflector Fence Gets Test

Smoke, heat, debris and some noise are deflected by section of Model CV 10-12 jet blast screen tested at Castle AFB near Merced, Calif. Fence consists of 10-ft.-long, one-ton sections that stand 12-ft. high when erected at 60-deg. angle. Air Force has erected 5,000-ft. fence at Castle. Exhaust blast is deflected 90 deg. upward by 18 curved, lateral vanes. Positioning fence at angle eliminates pressure buildup, permits unrestricted flow of high-velocity blast. Boeing designed screen, which was fabricated by John Bean Div. of Food Machinery & Chemical Co., San Jose, Calif.

STURDY, FAST ACTING RESISTANCE BULBS BY LEWIS

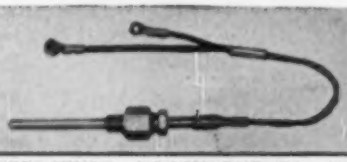
FREE AIR TYPE, MS28038-1 to MIL-B-8598



THREADED, PROBE TYPE MS28034-1 and MS28034-2 to MIL-B-7990

CYLINDER HEAD, BAYONET TYPE AN5546-1 to MIL-B-5491

PROBE TYPE, WITH ADJUSTABLE STAINLESS STEEL STUFFING-GLAND



FOR DEPENDABLE TEMPERATURE MEASUREMENTS, USE LEWIS BULBS WITH LEWIS RESISTANCE THERMOMETERS.

the LEWIS ENGINEERING COMPANY
naugatuck, connecticut

Nevada Test Site, Project 34.1 and 34.3, May 1956: $1.10; 122 pp.

UR-487 Species Difference in the Metabolism of Polonium 210, Apr. 1957: $.20; 17 pp.

UR-488 Some Effects of Thickness of the Layer in Protection Against Flash Burns by Creams, May 1957: $.20; 15 pp.

WT-1182 Utilization of Telemetering Techniques on Evaluating Residual Radioactive Contamination. Operation Teapot, Nevada Test Site, Project 30.2, Feb.-May 1955, Nov. 1956: $.25; 21 pp. **WT-1186 Measurement of Off-site Fall-out by Automatic Monitoring Stations, Operation Teapot, Nevada Test Site, Project 30.1, Feb.-May 1955, June 1957:** $.20; 20 pp.

UR-489 Protection from Radiant Thermal Energy by Fabrics Used as a Shield, June 1957: $.15; 10 pp.

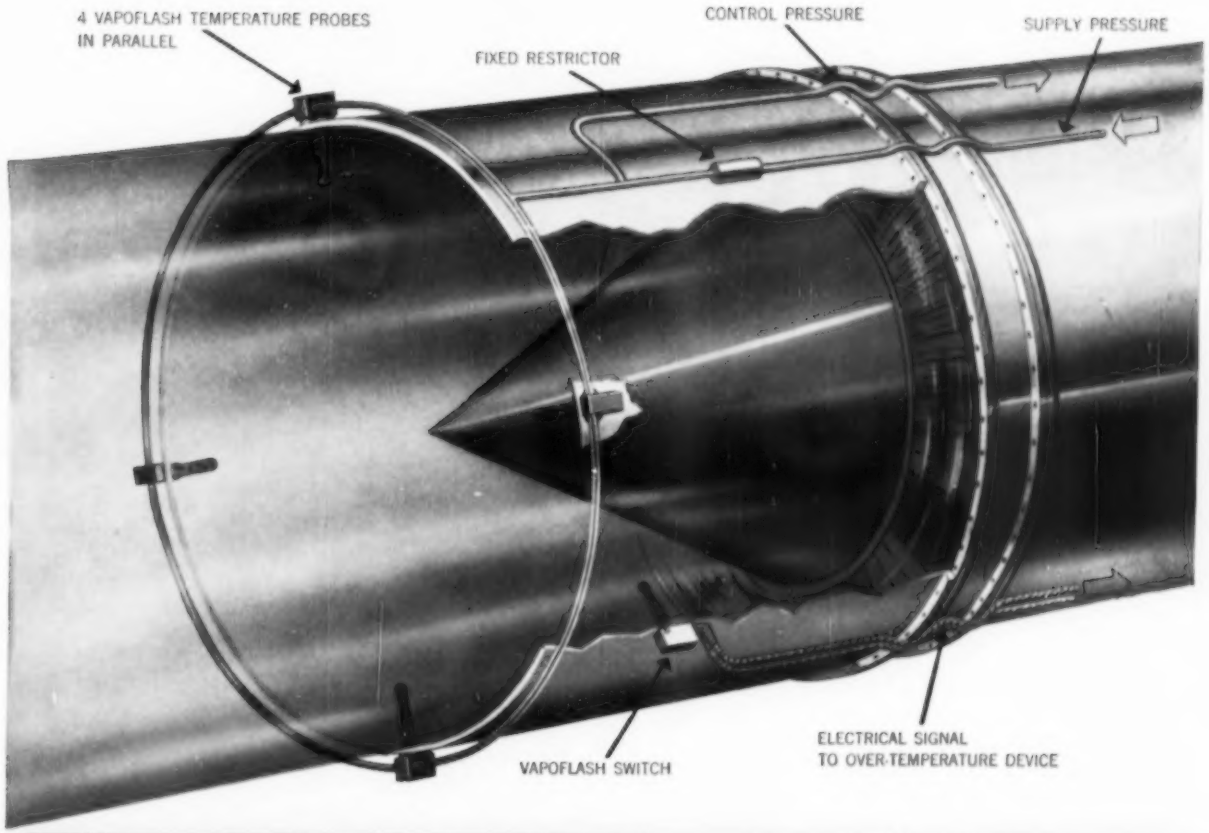
WT-1178A Beta Skin-dose Measurements by Specially Designed Film-pack Dosimeters, Operation Teapot, Nevada Test Site, Project 37.2 Feb.-May 1955, May 1957: $.25; 24 pp.

Telling the Market

Revision of **Screw Thread Standard H.28** and illustrated description of new gaging requirements, brochure, O-Vee Gauge Co., 3626 West Slauson Ave., Los Angeles 43, Calif. . . . Over four hundred **electrical products and fastening devices illustrated** and described, "Hi" catalog No. 12-B, Holub Industries, Inc., Sycamore, Ill. . . . Specifications of **electrical vacuum gages** for continuous measurement of low absolute pressure, Data Sheet 560, Vacuum Equipment Division, F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.

Prices, stock and delivery information on company's lines of **stainless steel and nylon fastenings,** catalog, Anti-Corrosive Metal Products Co., Inc., Castleton-on-Hudson, N. Y. . . . **RCA High Intensity Noise Systems** brochure (Form 3R3182) covers specifications, gives application information, describes testing procedure, etc., Radio Corporation of America, Electronic Instruments section, Bldg. 15-5, Camden 2, N. J.

Illustrated description of lubrication systems, automatic protections, and volumes and pressures of **unit type and Le Roi stationary air compressors,** two-color folder, Sales Promotion Dept., Le Roi Division, Westinghouse Air Brake Co., Milwaukee, Wisc. . . . Features and specifications of **hydraulic power packs** for simultaneous operation



VAPOFLASH FOR HIGH-TEMPERATURE MEASUREMENT... CONTROL... PROTECTION

Here Is How VAPOFLASH® Is Used:

Four or more VAPOFLASH PNEUMATIC PROBES are mounted in the turbine exit gas stream to provide an average measurement of the gas temperature. Compressor discharge pressure is fed through a fixed restrictor to a manifold pipe connecting all VAPOFLASH probes. The control pressure leads to the engine fuel control.

When the gas stream temperature acts upon the control band, the VAPOFLASH probes begin to bleed air to the atmosphere, reducing the control pressure proportionally. The power level of this control pressure signal is such that greatly simplified mechanisms can be used to modulate engine fuel flow. The VAPOFLASH technique is equally applicable to afterburner fuel control and variable exhaust nozzle control.

A VAPOFLASH SWITCH provides single-pole, single-throw electrical contact actuation at a desired gas temperature. When calibrated to a higher set point than the pneumatic probe, this unit will provide an electrical control signal for emergency over-ride action.

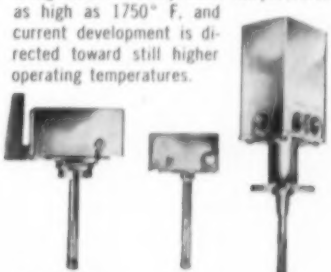
The VAPOFLASH principle is also available as a temperature probe to control fluid pressure directly as a function of temperature. This configuration is particularly advantageous when applied in a rocket gas generator control.

Get complete technical details and application data about VAPOFLASH in its three forms. We are confident that our long experience and extensive facilities for developing, manufacturing and testing jet engine control components can be of practical value to you. For full information and engineering counsel, please address your inquiry to our headquarters plant, Danbury, Connecticut.

THE VAPOFLASH

RUGGED... SHOCK RESISTANT... FAST RESPONSE... EASY TO INSTALL

Standard VAPOFLASH control elements are being used in steady state temperatures as high as 1750° F. and current development is directed toward still higher operating temperatures.



Electrical Contacts Output ... for Over-temperature Protection

Pneumatic Output ... for Air Powered Controls

Fuel Pressure Output ... for Fuel Powered Controls

MANNING, MAXWELL & MOORE, INC.

AIRCRAFT PRODUCTS DIVISION • DANBURY, CONNECTICUT • INGLEWOOD, CALIFORNIA

OUR AIRCRAFT PRODUCTS INCLUDE: TURBOJET ENGINE TEMPERATURE CONTROL AMPLIFIERS • ELECTRONIC AMPLIFIERS • PRESSURE SWITCHES FOR ROCKETS, JET ENGINE AND AIRFRAME APPLICATIONS • PRESSURE GAUGES THERMOCOUPLES • FUEL CONTROL VALVES • HYDRAULIC VALVES • JET ENGINE AFTERBURNER CONTROL SYSTEMS

PROJECT AND SENIOR PROJECT ELECTRONIC

ENGINEERS

Advance your knowledge, talents and personal growth in the most modern engineering and research laboratories. Gain swift, sure technical progress. Enjoy top responsibility, professional recognition including all AC-GM material benefits and advantages.

If you have a BS degree either as an EE or ME and have three to ten years applicable electronic experience, we offer you a broad range of challenging opportunities in the fields of *Avionics, Inertial Guidance, Computers (Analog-Digital), Jet Engine Fuel Controls, Automotive-Aeronautical Electro-Mechanical Devices.* Send resume *Mr. Cecil E. Sundeen, Supervisor of Technical Employment.

AC THE ELECTRONICS DIVISION

General Motors Corporation

Flint 2, Michigan • *Milwaukee 2, Wisconsin

of up to four fastener installation tools, Form 8-425, Huck Manufacturing Co., 2480 Bellevue Ave., Detroit 7, Mich.

Fabricating procedures and properties and applications of **17-4 PH and 17-7 PH stainless steels,** booklet P.O. 4757, Product Information Service, Armco Steel Corp., Middletown, Ohio. . . . Characteristics, application data and specifications of **porous sintered stainless steel filters,** Catalog 54-101, The Cuno Engineering Corp., Meriden, Conn.

Description and illustration of patented self locking, sealing and adjusting principle of **Nylok-Detroit threaded parts,** manual, Nylok-Detroit Corp., 1100 N. Woodward Ave., Birmingham, Mich. . . . **Machine Tool Controls** catalog for all types of machine tool users in aircraft, missile production, etc., True-Trace Sales Corp., 9830 East Rush St., El Monte 44, Calif.

Performance characteristics of redesigned, re-engineered and re-evaluated **IRC fixed composition resistors,** Technical Data Bulletin B-1C, International Resistance Co., 401 North Broad St., Philadelphia 8, Pa. . . . Color brochure describes **Hi-Torque Bolt configuration,** Hi-Shear Rivet Tool Co., 2600 West 247th St., Torrance, Calif.

Residual Stresses in Cold Finished Steel Bars and Their Effect on Manufactured Parts, pocket-size book, La Salle Steel Co., Hammond, Ind. . . . Application data on **Drive-Pin Blind Rivets,** catalog, Deutsch Fastener Corp., Dept. 36, P.O. Box 61072, Los Angeles 61, Calif. . . . Illustrated description of **standard rated gas-fired muffle furnaces,** Bulletin SC-179, Surface Combustion Corp., Toledo 1, Ohio.

Stacked Ceramic Tube

Stacked ceramic audio beam power amplifier tube, Type SN-2146B, capable of delivering 4½ watts under class A conditions at temperatures up to 300C, is now available in pilot quantities. Developed by Sylvania under Navy Bureau of Ships sponsorship, stacked ceramic tube also is available in Type SN-1724G, a high G_m, medium-mu dual triode, and SN-2225A, a high mu dual triode. Sylvania Radio Tube Division, Emporium, Penna.

ENGINEER OPPORTUNITIES AT RAYTHEON

FLIGHT TEST READY TO START as Raytheon engineer conducts final check. He works with some of our country's top design engineers on aircraft navigational and guidance systems.

Help design new coherent radar systems for aircraft navigation and guidance

Small project groups with full systems responsibility, working on the most interesting and advanced radar and navigational problems of the day – this is the atmosphere at Raytheon's Maynard Laboratory.

A company with many engineer-managers—experienced executives with young ideas—tends to create an exceptional environment for your professional development. Other Raytheon benefits: excellent starting salaries, regular reviews for merit increases; town or country living in beautiful New England.

We now have opportunities for men at all experience levels in:

CIRCUIT DESIGN	MICROWAVE DESIGN
ELECTRONIC PRODUCT DESIGN	RELIABILITY ENGINEERING
SYSTEMS ANALYSIS	TEST EQUIPMENT DESIGN
MAGNETIC COMPONENT DESIGN	SPECIFICATIONS WRITING

For more information on any of the above or other related fields, contact John J. Oliver, P.O. Box 87A, Raytheon Maynard Laboratory, Maynard, Mass.

RAYTHEON MANUFACTURING COMPANY
Maynard Laboratory
Maynard, Massachusetts

Are you the ONE MAN IN THREE?

RAYTHEON

Excellence in Electronics

Armco PH 15-7 Mo...

New High-Strength Stainless Steel

with guaranteed ultimate tensile strength of 225,000 psi

Commercially available in all forms. Offers new design possibilities for service up to 1000 F.

Armco PH 15-7 Mo is a new stainless steel specifically developed to meet the need for aircraft materials that will withstand the stresses and heat imposed on high-speed airframes. It is a precipitation-hardening stainless similar to Armco 17-7 PH, a grade that is used extensively in the newest and fastest aircraft and missiles.

Meets Industry-Specified Requirements

These are prime requirements for aircraft metals stipulated by aircraft manufacturers: Higher mechanical properties at room and elevated temperatures, good fabricating characteristics, availability in the forms and thicknesses needed, and good corrosion resistance.

All are met by Armco PH 15-7 Mo. It offers the best combination of characteristics for airframes that must operate up to 1000 F, including those designs requiring thin sheet and foil.

Typical Tensile Properties of Armco PH 15-7 Mo Sheets Condition RH 950

	75 F	600 F	800 F	1000 F
Ultimate strength, psi.....	240,000	204,000	183,000	129,000
0.2% Yield strength, psi...	215,000	173,000	155,000	100,000
Elongation, % in 2".....	6	6	8	14
Hardness, Rockwell.....	C48	—	—	—

Excellent Workability, Simple Heat Treatment

Armco PH 15-7 Mo can be fabricated readily by standard aircraft production methods. It is easily drawn or formed in the annealed condition, then hardened by simple, relatively low-temperature short-time heat treatment. In fact, fabrication methods and heat treatment for PH 15-7 Mo are identical to those for 17-7 PH stainless. Most aircraft manufacturers and their subcontractors already have production experience that can be applied to this new high-strength metal.

Additional Data Available

Get complete information on this special Armco Stainless Steel. See how it can be used to design for greater resistance to supersonic stresses and heat. A folder listing room- and elevated-temperature properties, available sizes and thicknesses, as well as information on heat treatment and fabrication is yours for the asking. Just mail the coupon.

New Armco PH 15-7 Mo Stainless Steel provides an outstanding combination of advantages for the design of supersonic missiles and aircraft:

- **... Guaranteed minimum ultimate tensile strength of 225,000 psi at 75 F (sheet, strip, thin gage strip)**
- **... Available in all forms—thin gage strip (foil), strip, sheet, plate, bar, wire, and billets**
- **... Exceptionally high strength-weight ratios**
- **... Better creep strength from 600 to 1000 F than any other metal sheet or foil**
- **... Excellent short-time tensile properties up to 1000 F**
- **... Most easily fabricated high-strength aircraft steel**
- **... Simple heat treatment minimizes distortion, facilitates production**
- **... Good corrosion resistance**

ARMCO STEEL CORPORATION
2077 Curtis Street, Middletown, Ohio

Send me your folder on new Armco PH 15-7 Mo Stainless Steel.

Name_____

Company_____

Street_____

City_____ Zone_____ State_____

ARMCO STEEL CORPORATION

2077 CURTIS STREET, MIDDLETOWN, OHIO

Sheffield Steel Division • Armco Drainage & Metal Products, Inc. • The Armco International Corporation

Navy Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by Navy contracting offices:

NAVAL AIR MATERIAL CENTER, Naval Base, Philadelphia, Pa.

Acme Precision Products Inc., Dayton, Ohio, energy absorber, type AA, MK. 1, Mod. 1; associated onboard spares for CVA 63; associated onboard spares for CVA 43; associated maintenance spares energy absorber assembly, type AA MK. 1, Mod. 1; Energy absorber assembly, same as above, for CVA 34; associated onboard spares; energy absorber assembly, same as above, for CVA 64; associated onboard spares; N156-34592 (IFB-156-244-57B), $107,080.

Baldwin-Lima-Hamilton Corp., Waltham, Mass., fluid pressure cell, to be equal in all respects interchangeable with Baldwin-Lima-Hamilton Corp. model SR-4, type HF N156-35018(IFB Neg 156/21322/57Q), $38,-530.

General Gas Light Co., Kalamazoo, Mich., adapter assembly, steel, emergency runway, arresting gear, N156-35528(IFB-156-17-58, 156/20055/58), $32,950.

NAVAL AIR STATION, Pensacola, Fla.

Panama City Tire and Recapping Co., Panama City, Fla., recapping and repairing of automotive tires and tubes, N204S-33100, (IFB-204-237-57), $75,262.

DISTRICT PUBLIC WORKS OFFICE, Fourteenth Naval District, Navy No. 128, Fleet Post Office, San Francisco, Calif.

E. E. Black, Ltd., P. O. Box 3203, Honolulu, Hawaii. Guided missile facility, U. S. Naval Ammunition Depot, West Loch Branch, Oahu, T. H. (IFB NBy 8002) $892,000.

DISTRICT PUBLIC WORKS OFFICE, Eleventh Naval District, San Diego, Calif.

M. H. Golden Construction Co., San Diego, Calif., extension of runway 18-36, Naval Air Station, North Island, San Diego, contract, NBY-7483, (IFB 7483/56B), $1,365,000.

BUREAU OF AERONAUTICS, Washington 25, D. C.

Lear Inc., Grand Rapids, Mich., pilot production armament control systems, NOas 57-801-C (AV-05-3512-57), $1,870,401.

AVIATION SUPPLY OFFICE, 700 Robbins Ave., Philadelphia, Pa.

Pacific Scientific Co., Los Angeles, Calif., indicators, (JD-IFB-383-1993-57), $45,890.

Douglas Aircraft Co., Santa Monica, Calif., ring assemblies, (383/2110-482A4/1/55), $40,101.

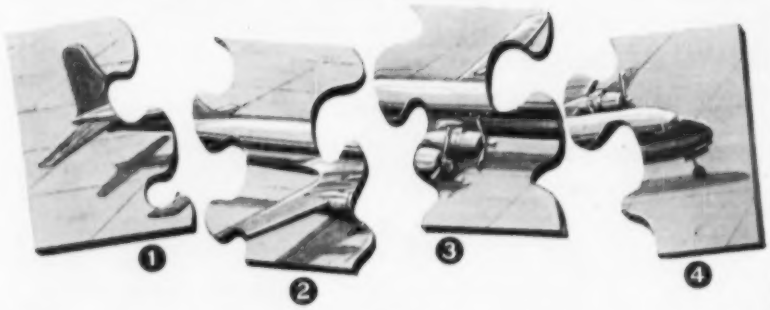
Grimes Manufacturing Co., Urbana, Ohio, flashers, (JD383/9031-246E4/1/58), $27,-750.

Gabb Special Products Inc., Windsor Locks, Conn., adapters, (JD383/9043-2854X1/1/58), $25,964.

Holley Carburetor Co., Warren, Mich., spare parts to support Holley fuel controls, (383/2118-3886/54/Aero), $60,765.

MAINTENANCE CLEANING:

Results improved



1 "Planes absolutely clean, free of oil, grease and dirt after washing with Oakite Composition No. 74."

So reports a major fleet service foreman. "No streaking of windows or aluminum . . . best of 6 materials tested." It's an almost neutral detergent, is mixed with water, sprayed on, let soak a while, and cold water rinsed.

2 "Oakite Renovator a 100% success for spot cleaning or 'dry' washing of planes,"

reports a leading service concern in N.Y. area. "Color comes up bright on painted smoke tracks, aluminum really glistens." This solvent is fast, easy, safe, dilutes with water for real economy.

Send for Bulletin F10059 that tells more about how to improve maintenance cleaning and save time and money. Write Oakite Products, Inc., 55 Rector Street, New York 6, N. Y.

3 "Engine parts perfectly stripped of all deposits, including paint, with Oakite Saturol."

Using this material full strength at room temperature in tanks, overhaul personnel at large Southern airbase also find that it cleans *fast*, and is safe for all metals.

4 "Results absolutely amazing cleaning ramps and aprons with Oakite Composition No. 74."

Leading airline at L.A. base spreads solution over entire area by truck, lets it soak for half hour, then rinses. No scrubbing. 100 lbs. now does job where 900 lbs. of former material were needed.

Export Division Cable Address: Oakite

OAKITE

Technical Service Representatives in U. S. and Canada

USAF Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by Air Force contracting offices:

HEADQUARTERS, SAN ANTONIO AMA, Kelly AFB, Tex.

Aircraft Division, Rheem Manufacturing Co., Downey, Calif., practice bomb, W/O spotting charge, MB-4, clamp, holding and release, MA-1, sling release, MG-1, and technical data, PR-SA-541388, SA-541388-1, SA-541388-2 and SA-541388-3, $1,285,280.

Pennington Channelchromium Co., San Antonio, Tex., cylinders applicable to R4360 engines, IFB 41-608-57-290; SA-7-02H2-2803, $53,300.

HEADQUARTERS, MOBILE AMA, Brookley AFB, Ala.

Pulsgrove Manufacturing Co., Winchester, Ohio, adapter assembly plate, multiple jettison assist takeoff, as per Republic Aviation Corp. drawing 1 and 37F74560, class 01N, AF 01 (601) 20608, $190,806.

MIDDLETOWN AMA, Olmstead AFB, Pa.

The Liquidometer Corp., Long Island City, N. Y., transmitters, indicators, RFP PR MA-7-05GG-260, $32,585.

HEADQUARTERS, TOPEKA AFD, Topeka AFS, Kan.

The American Platinum Works, Newark, N. J., silver solder, (IFB 14-604-57-1368), $66,138.

FAIN AFB, WASH., Purchasing and Contracting Office.

Associated Sand and Gravel Co., Everett, Wash., replacement of runway primary 111-118, Contract No. AF45(602)218 IFB 45-602-58-1) $98,666.

MEMPHIS AFD Mallory AFS, Memphis, Tenn.

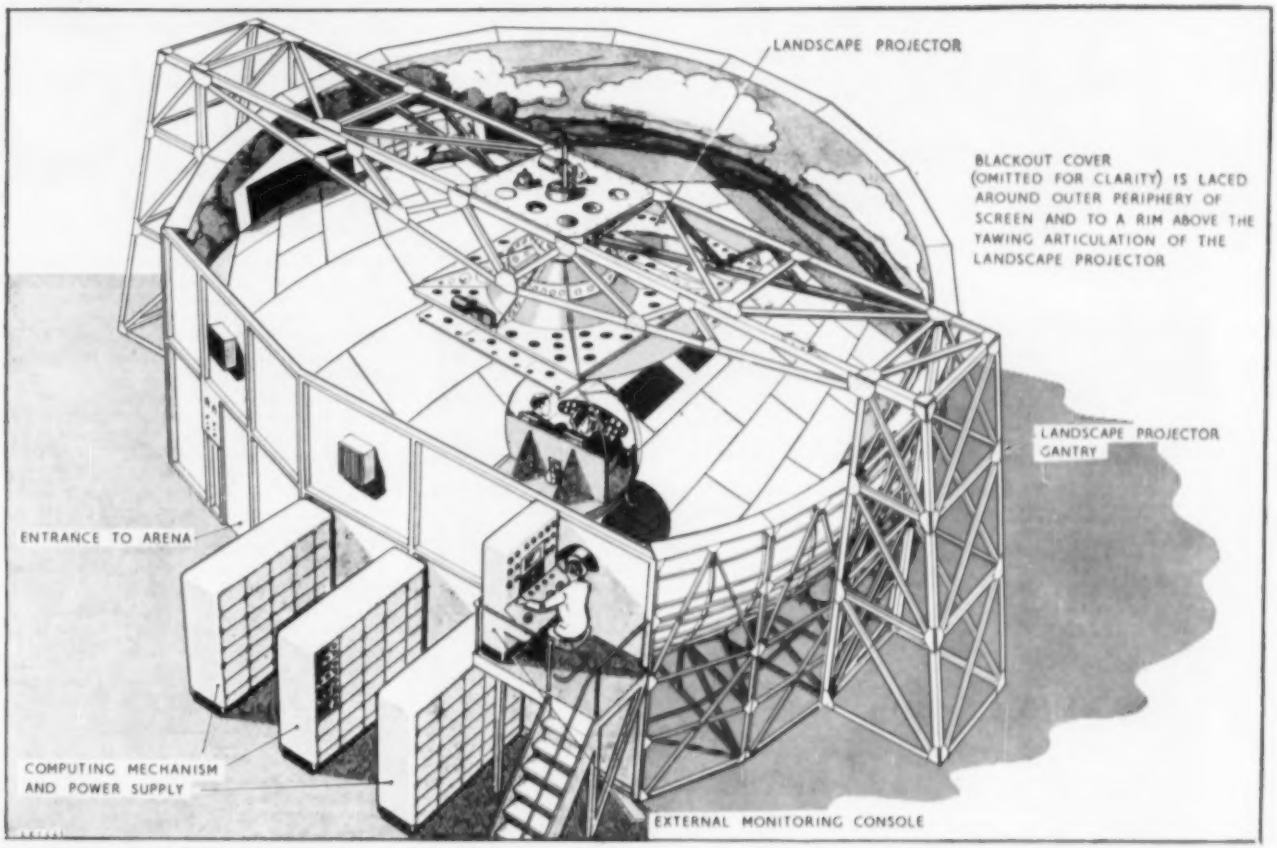
Leonard Spark Plug Co., Newark, N. J., spark plugs, (IFB 40-604-57-2168), $34,281.

The Barden Corp., Danbury, Conn., bearings, (IFB 40-604-57-2224), $88,800.

Hoover Ball Bearing Co., Ann Arbor, Mich., bearings, (IFB 40-604-57-2255), $26,800.

Bluff City Transfer and Storage Co., Memphis, Tenn., services, (IFB 40-604-57-2219), $26,873.

American LaFrance Corp., Elmira, N. Y., spares, (IFB 40-604-57-2243), $35,585.


LANDSCAPE PROJECTOR
BLACKOUT COVER (OMITTED FOR CLARITY) IS LACED AROUND OUTER PERIPHERY OF SCREEN AND TO A RIM ABOVE THE YAWING ARTICULATION OF THE LANDSCAPE PROJECTOR
LANDSCAPE PROJECTOR GANTRY
ENTRANCE TO ARENA
COMPUTING MECHANISM AND POWER SUPPLY
EXTERNAL MONITORING CONSOLE

ELABORATE PRESENTATION provided by new Short Brothers helicopter simulator is designed to provide realism in all phases of pilot training including instrument work. Computers govern action of two projectors to conform with all motions of the aircraft.

British Developing Helicopter Simulator

A helicopter simulator, designed to provide low-cost pilot training in primary and advanced phases, operational routines, emergency procedures and instrument work, is in advanced development by Research Department of Short Brothers & Harland, Ltd., Belfast.

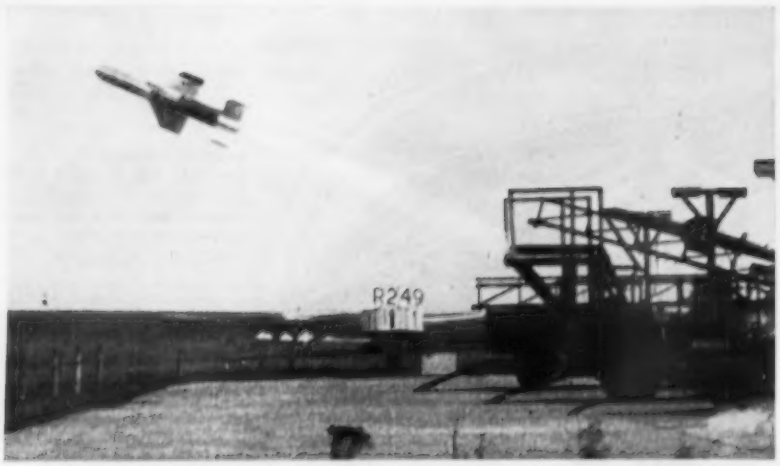
Equipment is suitable also for research into helicopter control and stability problems. It was designed to ultimately simulate a range of current and future rotary wing aircraft, using a computing system capable of providing the necessary data.

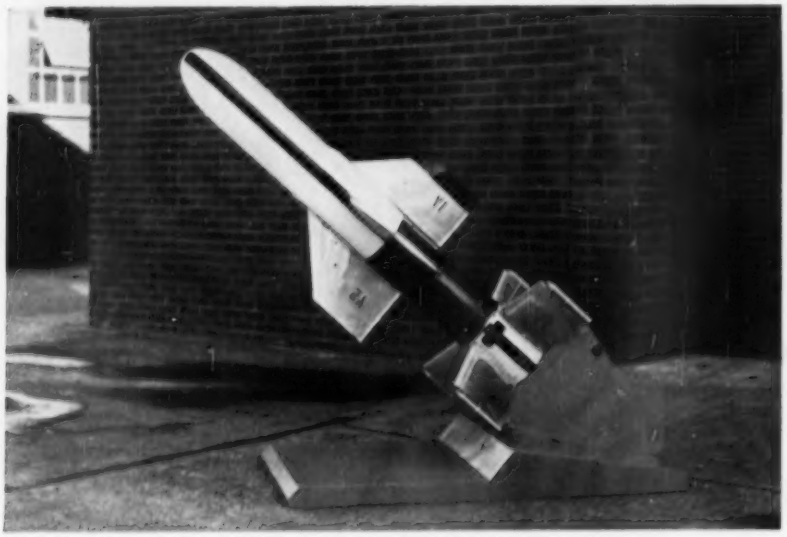
Present computer for training is an analog type fed with electrical input signals derived from potentiometers coupled to cyclic and collective pitch controls, rudder bar and throttle twist-grip.

Outputs representing aircraft attitude, rates and translation are fed to a projector which provides realistic terrain simulation and cabin servos and the simulated instruments.

Other computing loops provide the effects of air density and pressure with altitude development of induced flow

THREE-DIMENSIONAL LANDSCAPE can be "flown" by trainee under day or night conditions, its scale varying constantly as he climbs or descends. Future versions of simulator will permit training pilots in various models of current and future rotary wing aircraft.





Short Reveals Multi-Purpose Missile

Surface-to-air test vehicle developed by Short Brothers & Harland is shown at test firing (top photo). Photo at bottom shows the multi-purpose missile as it was exhibited for the first time at Farnborough this year. Its appearance at the air show was the first indication that Short Brothers was working on this project. The missile bears a resemblance to the French S.S.10 anti-tank missile, the Franch Matra O4 test vehicle and the U. S. Aerophysics Dart.

in various regimes of rotor operation—from the windmill air brake, through autorotation to the propeller working state—and the influence on this of forward flight and ground proximity. Noise generating circuits, monitored by engine and rotor speed computing servos, synthesize sound and vibration of these components—also, a rough air generator can be coupled into the aerodynamic blocks of the system as required by the instructor, who can also vary sea-level air density.

Short simulator enables the pupil to experience many of the actual physical sensations as well; servos on the axes of the cockpit mounting permit the fuselage pitch and bank attitudes to be controlled in response to his controls, except for very steep banked turns. Freedom in azimuth is unlimited. Yawing oscillations are not applied to the cabin, but change in heading is represented by traversing a color image projected on a curved screen surrounding the cabin. Image gives the pilot a sensation of a three-dimensional landscape or seascape stretching to horizon. Image can be varied to include both day and night conditions.

The projected landscape permits visual reference type "flights" within an area of 360-yd. diameter and up to 400 ft. height, to provide training in autorotation. Heights to the ceiling of a particular type helicopter can be simulated with appropriate instrument reading and control response.

Long Range Planning and Research at Marquardt...

by
Roy E. Marquardt
President

Although ramjet development in the Powerplants Division is the major activity here at Marquardt, there are three other divisions carrying on significant work; Controls and Accessories, Test, and Long Range Planning and Research.

The youngest of these Divisions is Long Range Planning and Research. Headed by John Drake, and numbering 50 engineers, the Division has two primary functions:

PLANNING — anticipating product trends in areas where we now operate or might enter. Actually this planning is done in a staff capacity, and normally the results end up as recommendations.

SUPPORT — to the other divisions, by introducing product improvements which offer promise for the future. These improvements generally involve a small scale program to establish the idea as feasible. This research function also may be concerned with areas which do not fit into present Marquardt projects.

Long Range Planning and Research was begun in 1954. One of its first studies concerned areas where the ramjet can now be used or where it might be used in the foreseeable future. To date some exciting new powerplant cycles have been plotted. Some are variations of cycles now in existence, others are radically different.

Projects also have probed new "exotic" fuels, new types of diffusers, accessory systems, and controls. One phase of Aircraft Nuclear Propulsion is now being explored.

Ground was broken near Newhall, California recently for a research test center. This aerodynamic facility will have testing capabilities to Mach 14.5 as a wind tunnel and Mach 10 for free jet testing with excellent simulation of full scale flight conditions (Reynolds Number). In addition, it will permit simulation of combustion conditions to Mach 8 and altitudes above 150,000 feet.

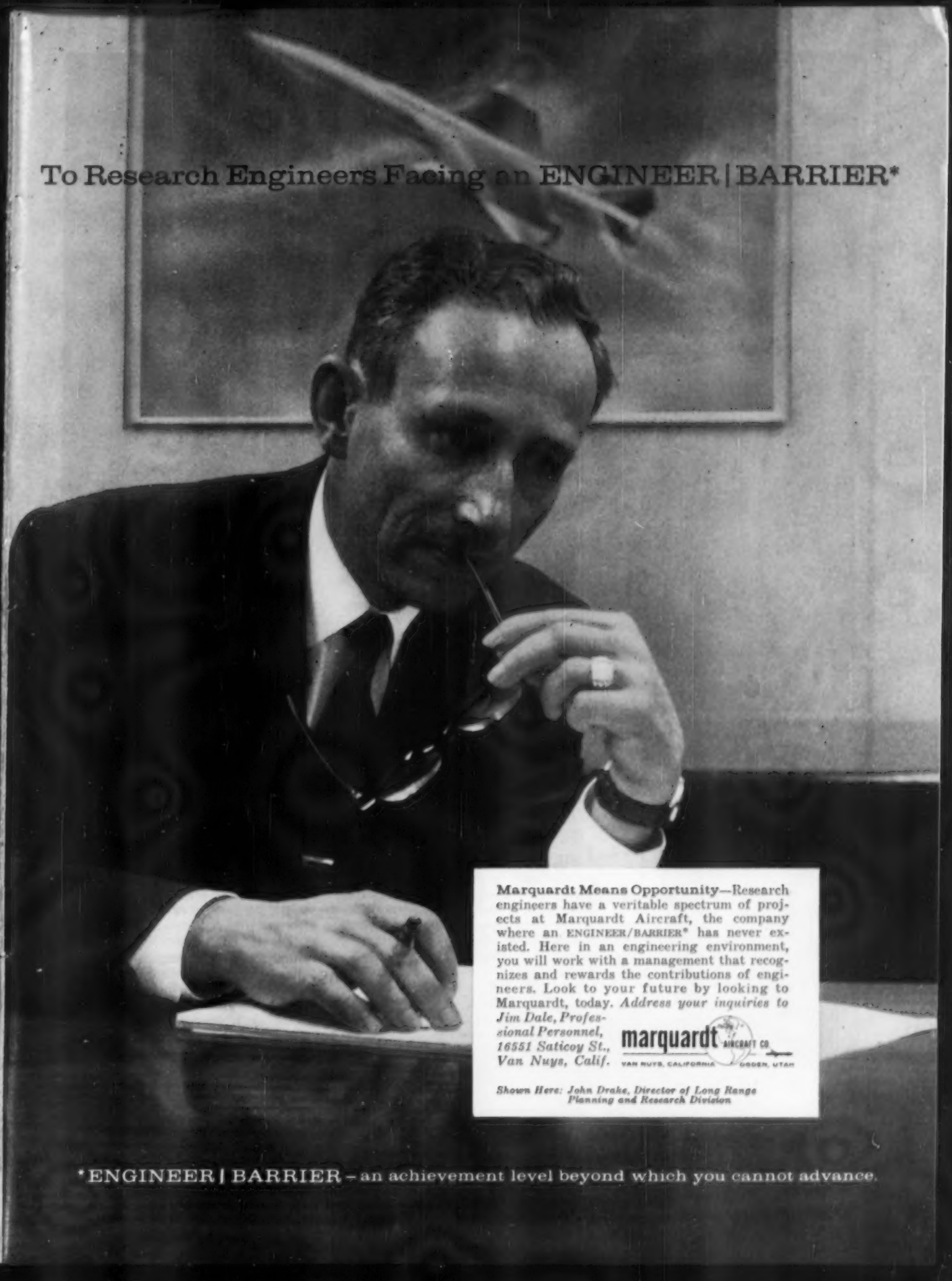
Within this Division, research engineers will find a spectrum of research engineering opportunities, including:

DESIGN	AERO-THERMODYNAMICS
NUCLEONICS	HEAT TRANSFER
CONTROLS	COMBUSTION

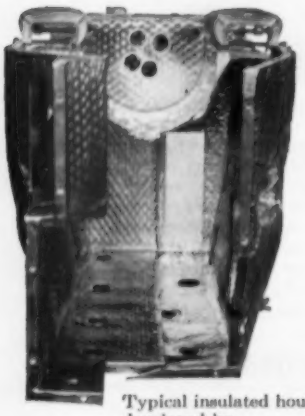
For information about these positions and the professional engineering environment at Marquardt, we invite you to write Jim Dale, Professional Personnel, today.

Roy E Marquardt

marquardt AIRCRAFT CO.
VAN NUYS, CALIFORNIA — OGDEN, UTAH
FIRST IN RAMJETS


To Research Engineers Facing an ENGINEER | BARRIER*
Marquardt Means Opportunity—Research engineers have a veritable spectrum of projects at Marquardt Aircraft, the company where an ENGINEER/BARRIER* has never existed. Here in an engineering environment, you will work with a management that recognizes and rewards the contributions of engineers. Look to your future by looking to Marquardt, today. Address your inquiries to Jim Dale, Professional Personnel, 16551 Saticoy St., Van Nuys, Calif.
marquardt AIRCRAFT CO.
VAN NUYS, CALIFORNIA
OGDEN, UTAH
Shown Here: John Drake, Director of Long Range Planning and Research Division
*ENGINEER | BARRIER – an achievement level beyond which you cannot advance.

you need a Thermoflex-insulated housing by Johns-Manville



Typical insulated housing developed by Johns-Manville for vital aircraft component.

In the *flying furnace* that is today's jet aircraft—or missile—components must still deliver maximum performance. That's why so many manufacturers of actuators, starters, pumps and electrical equipment are turning to insulated housings as developed by Johns-Manville. These housings are tailor-made for each component design. They fit snugly and form a continuous barrier against the scorching temperatures encountered at supersonic speeds.

Carefully fabricated of high-heat-resistant alloys, Johns-Manville housings are insulated with Thermoflex® refractory fiber felt. They are light in weight yet possess unusual structural strength and rigidity.

If your component is subject to failure from high temperature, get in touch with Johns-Manville. Experienced insulation engineers will plan a housing to give your component the protection it needs.

Write to Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PRODUCTS FOR THE AIRCRAFT INDUSTRY

Certificates of Necessity

Washington—Office of Defense Mobilization has authorized certificates of necessity for accelerated amortization totaling $17,047,977 for production of liquid oxygen and liquid nitrogen. A total of 60% of the estimated cost of that portion of each facility needed for the military production of the two materials is eligible for rapid tax amortization.

Largest contract, $4,098,844, was awarded to The New England Industries Inc., Fort Pierce, Fla. Other certificates awarded for the production of liquid oxygen and liquid nitrogen are:

Industrial Air Products Co., Portland, Ore., $755,000.
Big Time Welding Equipment Co., Houston, Tex., $1,380,695.
Dye Oxygen Co., Phoenix, Ariz., $173,000.
Air Reduction Co. Inc., Bassett, Calif., $2,653,250.
Big Three Welding Supply Co., Hurst, Tex., $578,500.
The Burdett Oxygen Co. of Cleveland Inc., Los Nietos, Calif., $495,330.
Pure Air Products Co., Augusta, Ga., $1,195,500.
Sierra Oxygen Co., Reno, Nev., $62,823.
Marks Oxygen Co. Inc., Augusta, Ga., $418,234.
The Liquid Carbonic Corp., Urbana, Ohio, $1,266,000.
Southern Oxygen Co., Greensboro, N. C., $915,081.
California Oxygen Co., Sacramento, Calif., $419,600.
California Oxygen Co., of Los Angeles, La Habra, Calif., $412,000.
Air Reduction Co. Inc., South Acton, Mass., $2,043,520.
The Liquid Carbonic Corp., San Francisco, Calif., $60,000.

W. Germans Activate Air Transport Unit

Bonn—German Air Force has activated first squadron of its transport command.

New squadron consists of 16 of 20 Douglas C-47 Dakotas recently purchased by the Defense Ministry. Full strength of the 61st Transport Wing to which new squadron is attached is fixed at 128 planes, chiefly 4-engine French Nord 2501 Noratlases.

Dakotas are strictly stop-gap equipment in GAF inventory. Twenty-five Noratlases are on order from the French, 11 of which have been delivered to Memmingen for pilot training.

A German Defense Ministry spokesman said replacement of the Dakotas with the Noratlas is scheduled to start soon.

License production in Germany of the Noratlas is not expected to begin before the end of year. Defense Ministry has ordered 112 Noratlases from Flugzeugbau Nord, one of four production groups set up in West Germany following the birth of GAF.

License contract is valued at more than $22-million.

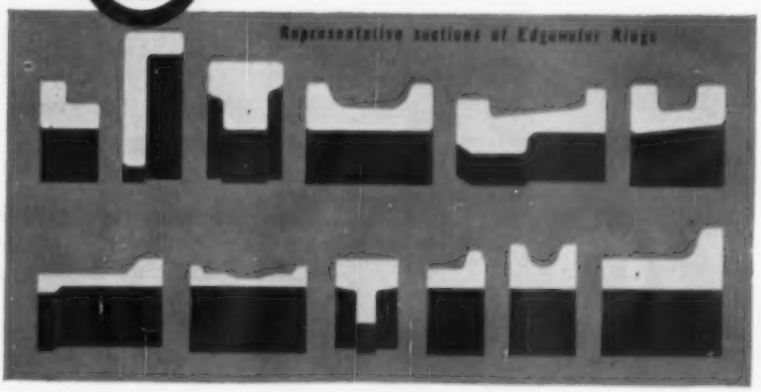
for ordnance equipment
jet engines, aircraft, missiles

Edgewater rings

save critical materials . . .
reduce costly machining . . .
meet highest quality standards

Your most critical specifications can be met by Edgewater Steel Rings—welded or weldless as required by the service. Formed accurately by modern methods, they are close to finish size as rolled. Weldless rings are rolled from solid steel blocks, in diameters from 5 to 145 inches. Welded rings up to 48 inches in diameter are formed from bars extruded or rolled to shape. Both types can be made in a great variety of sizes and cross-section shapes, as shown below. Being accurate in size and cross-section, Edgewater Rings save costly material and machining time.

Edgewater Steel Company
P. O. Box 478 • Pittsburgh 30, Penna.



ENGINE INLET location on Jetstar gives good ram recovery at all attack angles because wing acts as flow-straightening vane.

Lockheed Hopes Early Prototype Will

By Russell Hawkes

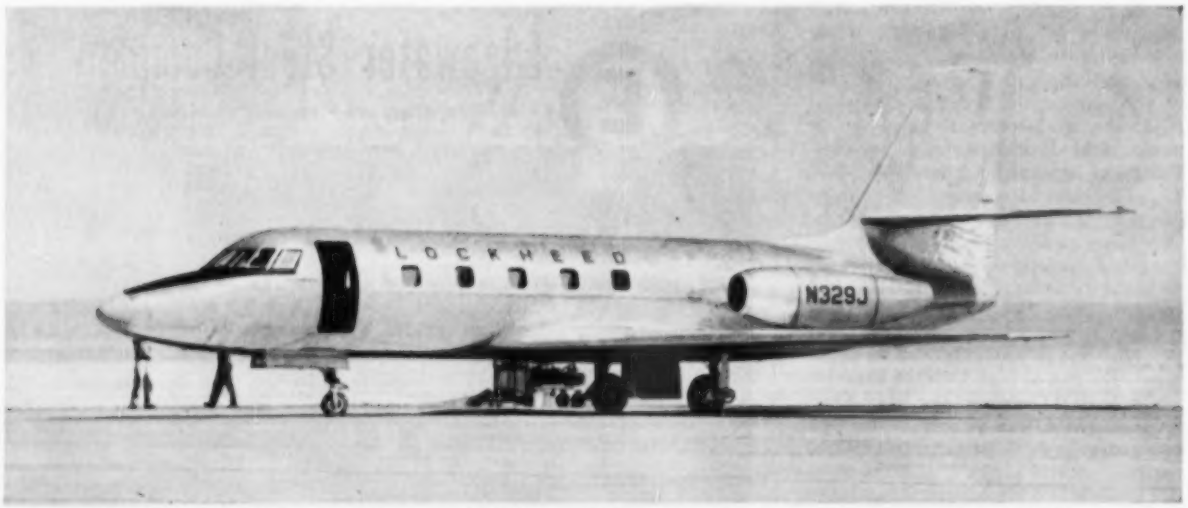
Burbank, Calif.—Lockheed CL-329 Jetstar, first light utility jet transport to fly, will be built at the company's Marietta, Ga., plant if and when enough orders are received to justify production.

It was moved from sketch pad to first flight in 241 days by a blue ribbon team of 41 engineers (prototype came within three pounds of predicted weight) and 310 technicians and administrators in response to a letter a year ago to 28 manufacturers from Maj. Gen. David H. Baker, then Director of Procurement and Production for Air Materiel Command. The letter stated a USAF requirement for such an airplane to be privately financed as a replacement for B-25, C-47 and C-45 aircraft now being used to haul high priority passengers and cargo and, presumably, to be offered on the civilian executive transport market (AW Feb. 13, p. 32).

Market Hopes

Lockheed hopes to get the USAF contract and skim the cream off the civilian business transport market by being first on the scene with a production airplane are based on complete prototype testing. Company officials also express hope that their foresight may land an order from the Navy. C. L. "Kelly" Johnson, Lockheed Vice President of Engineering and Research and head of the CL-329 design team, says the structure of the airplane is such that it could easily be modified for deck landings and catapult launches. Stall speed is only 75 kt., about the same as that of the last generation of propeller-driven carrier fighters. Best cruise speed is 440 kt. at 40,000-45,000 ft. Speeds are limited above 35,000 ft. to Mach .76 for climb, Mach .83 cruise and Mach .93 dive.

The production airplane will probably be powered by four General Electric J85 turbojets mounted in two-engine pods at the sides of the aft fuselage. The J85 produces 2,500 lb. thrust from a dry weight of 298 lb. and is designed for maximum economy. Another possible powerplant is the Fairchild J83, designed to the same USAF



FIRST PROTOTYPE of CL-329 is powered by two Bristol Orpheus 1/5 turbojets. Production plane may use four GE J85s.

TEST PILOTS report extension of Jetstar's ventral speed brake causes little change in trim.

Stimulate Jetstar Orders

specification. Choice between two may depend on availability which is problematical in both cases but no order has been placed for the J83. Lockheed hopes to have the J85 in the second CL-329 prototype which will fly next summer.

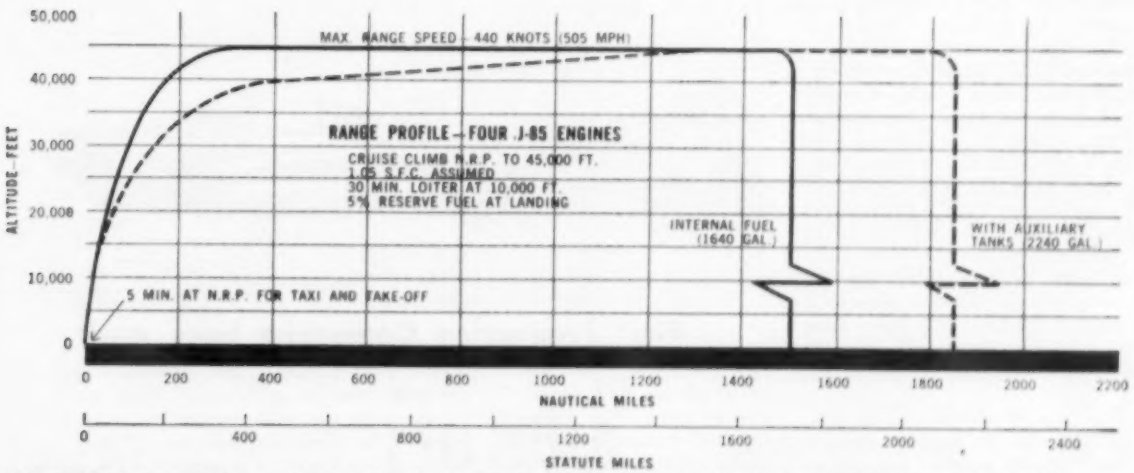
First prototype is now flying at Edwards AFB with two Bristol Orpheus 1/5 turbojets. It is possible that a production configuration of the 329 might use a pair of Wright TJ37 engines, increasing weight by 400 lb. The TJ37 is a license-built advanced version of the Orpheus, equivalent to Bristol's Orpheus 3/5, developing 4,850 lb. sea level military thrust with a dry weight of 850 lb. A shortcoming of the 1/5 model for the Lockheed application is the absence of accessory drives.

In the first prototype, airplane systems must be powered by a ram air turbine with its inlet on the leading edge of the engine pod strut in the middle of the low energy boundary layer along the fuselage.

Second Prototype

Metal is now being cut here for the second prototype. The airframe is expected to be complete by January. First flight will be delayed till summer awaiting delivery of J85 engines. Design of the second airplane will permit use of the TJ37 if the smaller engines aren't ready yet. Johnson's reason for going ahead on the second airframe so far in advance of engine availability is to clear CL-329 jigs and fixtures from the floor

FOUR-ENGINE configuration of Jetstar.



RANGE PROFILE shows design capabilities of production Lockheed CL-329 equipped with four General Electric J85 turbojets.

Lockheed CL-329 Jetstar

BASIC DATA

Length	58 ft. 10 in.
Height Overall	20 ft. 6 in.
Outside Fuselage Diameter	85 in.
Aisle Headroom	74 in.
Inside Width	75-79 in.
Wing Span	53 ft. 8 in.
Wing Area	523 sq. ft.
Aspect Ratio	5.5
Leading Edge Sweep	34 deg.
Horizontal Tail Span	24 ft. 9 in.
Horizontal Tail Area	149 sq. ft.
Vertical Tail Height (Above Center Line)	14 ft.
Normal Takeoff Weight	28,000 lb.
Maximum Takeoff Weight	32,400 lb.
Landing Weight	21,000 lb.
Thrust Ratio (Takeoff Weight to Military Power)	2.86

of Lockheed's experimental prototype shop to make room for later work without necessitating a second set-up.

Wings of the CL-329 are swept aft 34 deg. at the leading edge and have a thickness to chord ratio of 12% at the root and 9% at the tip. A mild conical camber cuts vortex losses and delays tip stall while retaining good high speed performance.

Wing Structure

Wing structure consists of ribs, extruded skin with integral T-section stiffening, some of which is chemically milled, and the conventional box-section main spar with integral fuel storage space inside. Wing box is not carried through the fuselage. Wing bending loads are picked up by five heavy circumferential frames in the fuselage through a heavy root rib to which the tank spar is joined. Limit load factor is 3.5, 40% higher than required by Civil Aeronautics Administration regulations CAR for transport category aircraft.

Johnson feels that in spite of the five beefed up rings, about 250 lb. of weight is saved from the usual carry-through structure. About 12 to 18 inches of headroom are saved in the forward end of the cabin with this design. Addition of 300 gal. slipper tanks halfway out along each wing to the 1,640 gal. in the tank extends range to 1,850 nautical mi. Slipper tanks feed into the internal tanks automatically as fuel is consumed. Maximum payload and full slipper tanks can be carried without exceeding the maximum take-off gross weight of 32,400 lb.

In the military application the CL-329 will be able to land at virtually maximum take-off weight. For civilian use, landing weight is 26,000 lb. Fuel can be bled off through dump valves at the wingtip trailing edges to get weight within landing limits in the event of an aborted flight. The airplane is refueled from the ground through fillers in each wing at 200 gal. per minute.

Fuel lines from the tank spar pass through the wing root fillet, into the fuselage aft section and out through the engine pods struts without entering the pressurized area or protruding outside the fuselage loft line. All fuel lines are shrouded in stainless steel and the shrouds are vented to the outside atmosphere. There is continuous cross feed between right and left fuel storage spaces.

Location of the engine inlets above and about 15% of root chord forward of the wing trailing edge results in good ram recovery at all angles of attack because the wing serves as a flow straightening vane for the inlets. At an 18-deg. angle of attack, angularity of flow at the inlet is only two or three degrees. Wing also prevents ingestion of foreign objects during ground operation. Location of the engines ordinarily improves flow over the wing but deliberate blockage by reducing inlet flow rate has been discussed as a means of insuring that center section stalls ahead of tips. Position of engines aft of the pressure bulkhead lessens noise level and danger of cabin penetration by fractured compressor or turbine blades.

Jetstar has 60% span boundary layer control flaps. Low energy boundary layer above the wing trailing edge is energized by exhausting engine bleed air over the upper surface of the flap. Bleed air is ducted through the flap itself and ejected aft through orifices in the flap upper leading edges. Since the flap hinge moves aft as the flap is extended, an unusual duct slip joint which Johnson calls a "trombone fitting" is required. Boundary layer control is expected to knock 7-10 kt. from the stall speed of the J85 powered airplane. It is much less effective on the first prototype because of the low compression ratio of the Orpheus engines. Full-span automatic leading edge slats cut another five kt. from stall speed to get it down to 75 kt.

Variable Tail

Rudder control of the CL-329 is aerodynamically boosted. A novel pitch trim device varies stabilizer incidence by changing the sweep of the vertical fin to which the stabilizer is rigidly attached. Angular motion of fin and stabilizer covers nine degrees (from

First Production Comanche Goes Aloft

First production model of new four-place Piper Comanche business plane is shown over the clouds near Lock Haven, Pa., where the planes are manufactured. Piper has set a production target of one Comanche per day in January, with eventual output of five daily expected. Powered by a 180-hp. Lycoming, the Comanche cruises at 160 mph. at 75% power and has a range of about 900 mi. at this speed. At economical cruise power, the plane has an endurance of 7.5 hr. or 1,100 mi.

plus 2 deg. to –7 deg.). High speed trim settings also provide more fin sweep. Fin and stabilizer are adjusted by an electrically powered screwjack actuator in the fuselage tail section acting upon the root of the forward fin spar. Hinge-point is at the root of the aft fin spar. Fin leading edge moves inside the dorsal fillet without much effect on the smooth curvature at that point.

Johnson says this means of varying pitch trim is better structurally than the more usual method of varying stabilizer incidence while the fin remains fixed. Hinge and actuator loads can be picked up at the heavy spar roots rather than in the constricted space and lighter structure near the joint.

Test pilots report that extension of the ventral speed brake causes little change in trim. The brake is perforated and its hinge moves aft on a track as it is extended to exert a nearly pure drag force far aft to the center of gravity.

Cockpit Layout

Cockpit layout is standard with average visibility and radio controls centralized in the control pedestal. Two pilots are preferred for ordinary operation but it is possible for the airplane to be flown by one man if necessary. All instruments and controls except for the circuit breakers are within reach of the left seat. A nosewheel steering wheel is located to the pilot's left, but the plane can be steered on the ground with brakes if necessary.

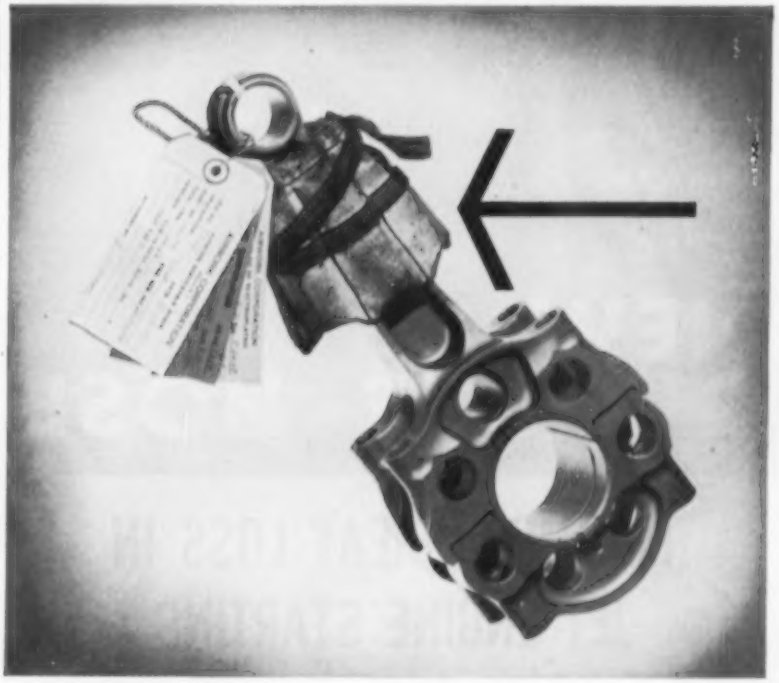
Both pilot and copilot have Collins MA-1 integrated flight instruments. An engine ground test switch enables the crew to check all engine circuitry in one operation. A failure at any point flashes a red warning light when the switch is depressed to show that a more detailed trouble shooting procedure is required. An automatic check list is mounted on the instrument panel and individual points on the list are illuminated from behind the panel when a system is inoperative, tail pipe temperature limits exceeded, critical fuel level passed, etc.

In a complete hydraulic failure, the main landing gear is unlocked manually at the wheel wells under the galley and the aft baggage compartment and extended by gravity. The forward retracting nosewheel is unlocked by a toggle in the cockpit ceiling and extended by gravity and drag.

The 500-mph-plus CL-329 is almost large enough to be termed a DC-3 replacement. In its standard passenger version, it will carry 10 passengers in comfort and will be priced in the neighborhood of $800,000 less engines and avionics. The USAF convertible passenger-cargo version with troop carrier seating will carry 18 passengers and will haul cargo at a rate of 814 ton/knots over a 1,500 nautical mile range. Payload is 4,000 lb. and cargo cabin volume is 716 cu ft. in the passenger version. The center aisle floor is about nine inches lower than the floor under the seats, giving 6 ft. 2 in. of headroom. When converted to cargo, a panel is bolted over the aisle to produce a level cargo floor stressed for 16 G decelerations with cargo tiedown rings spaced 20 in. apart laterally and longitudinally. Permissable load density is 10 lb. per cu. ft. cabin volume.

Crash Resistance

The first prototype has the standard passenger interior with 10 single seats arranged with five on each side of the aisle and a longitudinal spacing of 40 in. on centers. The seats in the prototype are stressed for only 9 G but the seats in later airplanes will be stressed for 16 G to take advantage of the crash resistance inherent in the airplane structure. Two heavy fuselage keel members should make for safe belly landings. Abolition of half the carry-on baggage space, the galley and spacious lavatory aft should make it possible to add six more seats to this configuration. The standard galley has a heating oven with a 12-tray capacity and a coffee maker. A more plush executive interior has forward and aft convertible seat-berths for



Why Should An Inspector Do This?

Because the correct fit of link pins to a master rod is a high precision job. Only a difference of 0.0003" in diameter makes the difference between a pin that fits correctly, and one that doesn't!

At Airwork, 54 different diameters of link pins are needed to correctly fit master rods on just one popular engine. Naturally, it takes an inspector, equipped with the best of precision gauges to select the pins that fit exactly.

Those pouches keep pins and the mating rod together; protecting the pins until they reach final assembly. This is just one more Airwork procedure that helps produce a longer lasting trouble-free engine.

Airwork CORPORATION
Millville, New Jersey

BRANCHES IN:
WASHINGTON
NEWARK • MIAMI • ATLANTA
CLEVELAND

six with a stateroom and room for perhaps four more passengers on a sideward facing lounge.

There are two air evacuation configurations to carry litter patients and walking evacuees as well as four attendants. A global interior for long flights has eight seats, a lounge-berth and a berth for a third crew member replacing the aft lavatory of the standard configuration. Lavatory of the global interior is forward, behind the copilot in space used for carry-on baggage in the standard version.

Passenger entry is forward on the left side. Entry stairs fold inside the doorway manually. A double-hinged plug door is used to prevent accidental opening when pressurized.

Cabin Pressure

Cabin is pressurized to a cabin altitude of 8,000 feet at an outside pressure altitude of 45,000 feet. Cabin pressure controller is a standard item manufactured by AiResearch. Cabin structure is the same fail-safe or ripstopper design used in bigger jet transports to prevent local skin failure from spreading and destroying primary fuselage structure by explosive decompression. By the time the airplane is ready for production, extensive fatigue testing of all structures will have been completed. Auxiliary oxygen is supplied to each passenger and crew seat from a single system and provisions are included for recharging the crew walk-around bottle from the primary system.

A large volume, low velocity air conditioning system is used to eliminate drafts and whistling. The system has air cycle refrigeration. Main ducts run along the sidewalls through the outboard arm rests of the seats. A controllable cold air jet and reading light are installed at each passenger seat and an overhead aisle light is between each pair of seats.

Air conditioning along with all other airplane systems is driven by engine accessory pods. Operation of one engine will drive the air conditioning on the ground as well as vital hydraulic and electrical services. All system power units are located in a compartment just aft of the cabin pressure bulkhead and just inboard of the engine pods. This minimizes the distance that accessory power must be transmitted and centralizes hydraulic reservoirs and pumps, electrical generators, air conditioning motors, etc., at one convenient place for easy maintenance. Two baggage boxes are in the same compartment.

There are two separate hydraulic systems, each with its own engine-driven variable volume pump and reservoir. Hydraulic-powered components are divided between the two systems but both drive the duplex aileron boost. Brakes

NEW QUAKER HOSE

MINIMIZES HEAT LOSS IN JET ENGINE STARTING

additional jacket prolongs service life

From upstream to downstream end, this tested-and-proven Quaker hose holds the heat. In fact, temperatures of from —80 F. to 450 F. hold no terrors for this toughie.

Neither does pressure. This hose has delivered 125 lbs. per minute of 425 F. air for 200 hours at 65 psi pressure. The schedule called for three hours on operation and one hour off.

This light and flexible hose comprises two silicone rubber layers covered by a synthetic fiber jacket. An extra outer jacket of corrugated rubber protects it against wear and abrasion. Lengths are continuous up to 50′. Couplings can be regular expansion and shank hose.

Write today for complete details to Quaker Rubber Division, H. K. Porter Company, Inc., Philadelphia 24, Pa.

H. K. PORTER COMPANY, INC.
QUAKER RUBBER DIVISION

and other vital components may operate off either system at the option of the pilot. If either system should be lost the other would provide adequate aileron boost. Conventional cable controls backstop the boost circuits. One system includes a battery or ground power driven electric pump for ground operation.

Escape Chute

The speed brake does double duty as an entrance to the unpressurized aft baggage and systems compartment. An inward opening hatch is above the speed brake to prevent turbulence in the compartment when the brake is extended. In answer to a USAF desire for parachute escape provisions, Lockheed has proposed an escape chute through the unpressurized aft compartment which would be entered through a hatch in the pressure dome and left through the space cleared by extension of the speed brake.

Weather radar specified for the CL-329 will probably be the RCA APS-42 with a 24-in. dish antenna unless lighter equipment is made available. The electrical system draws a.c. power from a 1,500-v.a., 115-v., three-phase, 400-cycle cycle inverter with a 250 v.a. standby inverter. Two 350-amp. starter-generators supply d.c. power with two 12-v., 75 amp.-hr. high-rate discharge batteries in series connected to the bus for partial voltage stabilization and emergency power.

New Finance Plan Given Cessna Dealers

A new finance plan to allow dealers to purchase demonstrator aircraft at lower initial cost and on smaller payments is being offered by Cessna Aircraft Co.'s subsidiary National Aero Finance Co.

Under the new plan a dealer can purchase a $10,000 Model 172, for example, for $800 down and finance the balance over 24 months.

First month's payment would be $248 and payments would decrease each succeeding month.

In addition to allowing the smaller dealerships to purchase additional demonstrators at lower cost, the plan is also seen by company officials as permitting more operators to take on a Cessna dealership.

Small Plane Arrivals Set Record at Piper

Lock Haven, Pa.—More than 2,300 persons arrived here in more than 650 private and business airplanes recently to help Piper Aircraft Corp. celebrate roll out of its 45,000th airplane, a new world record for civilian aircraft production.

It is believed to have been the largest number of airplanes to show up at one airport for a single-day event.

High density of arriving traffic made it impossible to provide individual landing instructions—at times there were up to 15 airplanes in the traffic pattern simultaneously and landings were being made at the rate of eight planes a minute.

Departures were made in a stream takeoff, with a flagman on the runway signaling planes off at approximately 10-sec. intervals. Not a single airplane was scratched during landing or takeoff.

A Piper PA-23 Apache light twin, airplane No. 45,000, was presented to President W. T. Piper, Sr., as his private transport.

CONVENTIONAL CONFIGURATION marks 150-mph., four-place Maule M-4, shown in flight test at right. Photo at left shows how two wide doors on right side, another door on left, make access to cabin easy. Powerplant is 145-hp. Continental with Fiberglas cowling.

Aircraft Equipment Manufacturer Considers Lightplane Production

Jackson, Mich.—An established light aircraft equipment manufacturer here is studying the market potential for a new four-place single engine business plane which he estimates would cost about $7,000 in production quantities.

B. D. Maule Co. has been flight testing a prototype Bee-Dee M-4 for over 100 hr. and reports that no adverse flying characteristics are noticeable.

Cursory look at the M-4 indicates that Maule has borrowed liberally from some well-established lightplane designs; the vertical tail, for example, closely resembles the Piper Pacer in configuration. President B. D. Maule has been flying since 1932 and has built several lightplanes and sailplanes for his own use since then. Currently the firm builds tailwheels, fabric testers and similar small items.

Powerplant is a 145-hp. Continental engine enclosed in a Fiberglas cowling. Top speed with this engine is stated to be 165 mph., cruise speed 150 mph. Landing speed, using mechanically actuated flaps, is 48 mph. Range is given as 550 mi. with 36 gal.

The Bee Dee spans 30 ft., is 22 ft. long and weighs 1,050 lb. empty.

Cabin features three-door entry, one on each side, with additional door for rear seats on the right side. Plane is fitted with a 12-v. electrical system.

Coordinated turns can be made using a tab on the rudder mechanically linked and synchronized to aileron action, obviating need for rudder pedal action.

Basic construction is steel tube fuselage with wood fairing strips. Wing is built up of aluminum alloy, fabric covered, with molded Fiberglas wingtips. Landing gear is of the tailwheel type, inner legs of the main gear having individual compression springs where they join under the fuselage, a simpler shock absorbing system than the air-oil cylinder type, Maule points out.

Aerial Sprayers, Dusters Grossed $90-Million in Year, NATA Finds

Washington—U.S. spray/dust operations grossed more than $90 million in 1956 on a total investment of some $75 million, National Aviation Trades Assn. estimates on the basis of a recent survey of the industry.

The association's survey, covering about one in 15 applicators in the country, including 30 of the most active agricultural states, provides valuable updating of usually scanty information on this segment of business aviation. Survey was developed by Robert Monroe, Prescott, Ariz., while he was president of the association's agricultural activities.

Survey returns provide this picture of the "average" air applicator: he has a capital investment of $48,000 and an income of $58,400. Revenue flying totaled 761 hr. last year and covered 5.2 months of operation. In this time he treated just over 57,000 acres, employing 9.2 people either part time or full time.

Average agricultural air applicator concern dispensed 68,300 gal., including concentrated chemical and carrier; total powder dust distributed averaged 367,510 lb.

Overall, spraying overshadowed dusting by 4:1 ratio, with fertilizing next in acreage covered.

More than half the replies to NATA's survey indicated that business was entirely, or nearly all, concerned with aerial application. According to the replies, 83% of the key people in applicating firms flew spray/dust "missions."

Piper aircraft topped the list in number of agricultural planes used; only 5% reported using multi-engine planes. Firms used an average of 4.2 aircraft in 1956.

As regards financial status, 43% of the applicators replying had a capital investment under $20,000. At the extremes was one company that reported an investment of $500,000. A large number of firms stated that their investment ran from $150,000 to $200,000.

With reference to gross revenues, the largest gross averaged some $15,000 with about 10% of the returns falling equally in the categories of $10,000, $25,000, $45,000 and $125,000. Revenues of up to $200,000 gross were reported by 6%; two operators achieved over $200,000.

As regards accidents, the replies indicated that spraying accounted for about five times the number as dusting; this must be adjusted in light of the fact that about four times as much acreage was sprayed as dusted.

Considerable opinion was expressed as to problems and needs by the spray/dust applicators:

- **Shortage of trained** agricultural pilots was reported by 80% of the replies; an even higher percentage stated a definite need for agricultural pilot schools.
- **Need for a herbicide** to control wild oats in wheat and small grains was the single most-mentioned item in the reports. Also noted several times was a need for a selected grass killer to control cheat grass in wheat, a herbicide for wild buckwheat in wheat and small grains, and a non-toxic chemical to fight the aphid in alfalfa and clover.

In reply to the question "what single development do you think would do the most to extend your season or increase the market for your services?" the replies could be summarized as follows:

- **Chemical** that would dry up all weeds and defoliate soybeans so that they could be harvested a week from application.
- **Chemical spray** to effectively and economically hasten decomposition of straw and stalks.
- **A true defoliant** on short staple, dry land cotton.
- **A chlorinated hydrocarbon** for alfalfa aphid that would work in cooler weather.
- **Pelleted** DDT.
- **Good fungicide** that could be sprayed from the air at low gallonage per acre for apples, peaches, tomatoes and potatoes.
- **Better chemicals** to work on brush during a longer period of the summer regardless of moisture.
- **A weed** (cocklebur) control in soybeans.
- **Liquid spray** control of plant diseases at low volume.
- **A cheap carrier** other than diesel oil with just as good spreading, penetrating and non-evaporating characteristics.

Also sought by applicators is a concentrated fertilizer that can be dispensed more efficiently from the air to enable aerial applicators to compete more effectively with ground applicators.

Brazilian Lightplane Starts Tests

First photo of the Omareal W-141 shows four-place all-metal lightplane prior to start of its flight test program recently. Speed with a 225-hp. engine is approximately 135 mph. Useful load is 1,265 lb. Fully loaded, it is designed to take off in 650 ft. It has a three-blade variable pitch propeller. Shops in Botucatu, Sao Paulo, Brazil, are being set up for production of the new lightplane.

PRIVATE LINES

Goodyear lighter-than-air-ship will be used by Chrysler Corp. in late summer-early fall promotion schedule for new car line. During daylight hours the airship will tow an 80-ft. banner, at night two messages will be flashed on and off using 11-ft.-high illuminated lettering. A total crew of 11 men are assigned to handle the airship aloft and on the ground during its tour.

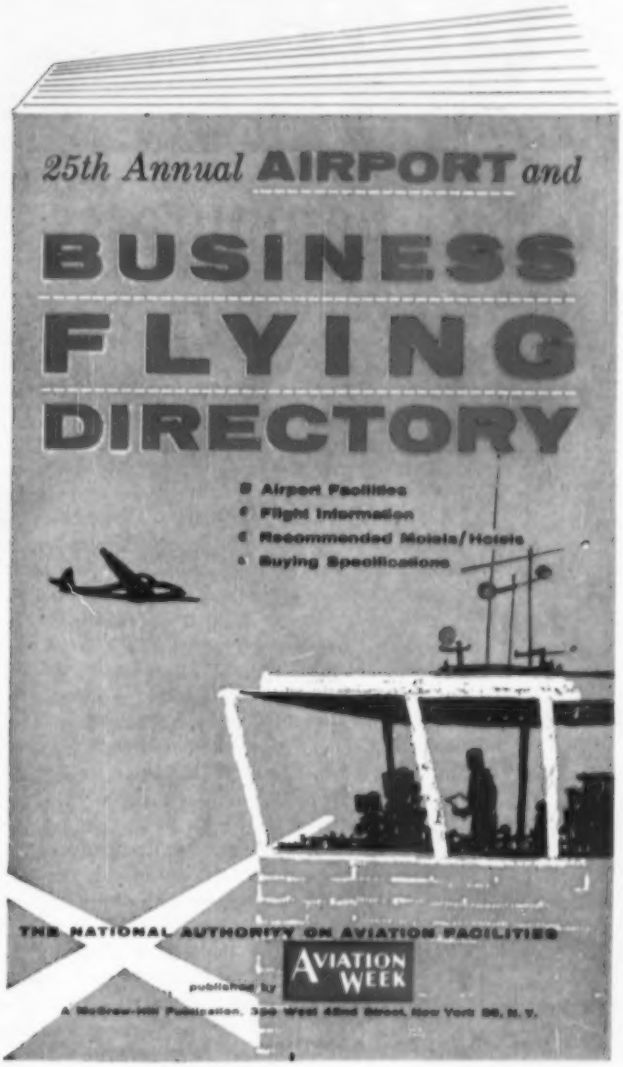
Mooney Aircraft is expanding its Kerrville, Tex., plant by spending $100,000 on a sheetmetal-forming department under a new roof. Firm recently signed a 50-yr. lease for its factory site.

Conversion of World War II Wirraway trainers to agricultural duties is planned by Commonwealth Aircraft Corp., Melbourne, Australia, the original manufacturer. Wasp-powered Wirraway conversions are expected to sell for about $20,000. Planes, renamed Ceres, will be fitted with a hopper

PILOTS! make your flying surer...

save yourself time, trouble and expense at your destination know what's ahead

New .....



- Over 6,500 Airports Listed by State
- Principal Airports Located on State Maps
- Airport Chart Locations Given
- Runway Lengths; Surface; Directions; Condition
- Approach Obstructions
- Lighting; Field Markings
- Control Tower Frequencies
- Omni, Low Frequency, Homing, etc. Frequencies
- Ground Transportation Services
- Restaurant and Recreational Facilities
- Recommended Motels/Hotels, Rates, etc.
- Fuel, Maintenance, Storage Services
- Weather Station Phone Numbers
- CAA Information Station Phone Numbers
- U.S. and Foreign Entry, Exit Requirements
- ADIZ Map
- Equipment Illustrations; Buying Specifications

GET AVIATION'S MOST USEFUL CROSS-COUNTRY FLYING GUIDE. LAST YEAR MANY ORDERS WERE UNFILLED DUE TO EARLY "SELL OUT". MAIL COUPON NOW!

only $5.00

AIRPORT AND BUSINESS FLYING DIRECTORY
330 West 42nd Street, New York 36, N. Y.

Please send post-paid my copy of the AIRPORT AND BUSINESS FLYING DIRECTORY to the following address:

Name: _____

Address: _____

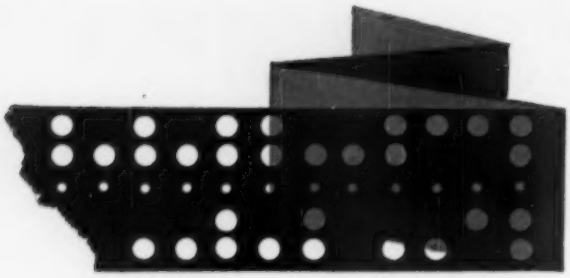
City: _____

Company: _____

Aviation Interest: _____

Bill Company ☐ Check enclosed ☐ $5.00 enclosed ☐

AW1



computers

Northrop needs computing analysts, qualified either by experience or education, to work in their ever-expanding Computer Center at Hawthorne, in Southern California. If you are qualified, there is an interesting position as well as a bright future for you at Northrop.

Applied mathematicians and engineers are needed as computing analysts for assignment to Northrop's analogue computing facility, as well as their enlarged digital electronic computer department which provides unparalleled service in the practical solution of complex engineering problems.

Your assignments will be fresh and stimulating, and you will have frequent opportunities to advance in your field. Besides an excellent salary, you will receive company-paid benefits that are unexcelled in the entire aircraft industry. Your colleagues will be the brilliant engineers who developed the USAF-Snark SM-62 intercontinental guided missile and the new USAF-Northrop T-38 supersonic twin-jet trainer. These men are congenial and helpful, and will respect your ability and individuality just as Northrop expects them to do. And you and your family will fully enjoy Southern California's many attractions and its delightful all-year climate.

If you qualify for any phase of computer research, design, or application, we invite you to contact the Manager of Engineering Industrial Relations, Northrop Division, Northrop Aircraft, Inc., ORegon 8-9111, Ext. 1893, or write to: 1041 East Broadway, Dept. 4600A, Hawthorne, Calif.

NORTHROP

Northrop Division of Northrop Aircraft, Inc.

BUILDERS OF THE FIRST INTERCONTINENTAL GUIDED MISSILE

carrying about one ton of fertilizer. Fuselage will be lengthened two ft. and wing area will be increased about 30%. Retractable landing will be fixed in the down position; wing flaps will be fixed at about 10 deg. down.

IRAN contract for Cessna L-19As operated by U. S. Army within Sixth Army area has been awarded Erle L. Bacon Corp., Santa Monica, Calif. Work will be done at Thermal Airport, recently leased by the service firm.

First three of an order of 15 A-75 agricultural aircraft have been delivered by National Aircraft Corp., Burbank, to Crop Care, Inc. Total contract is for $225,000.

Flexible wing fitted to a Taylorcraft BC12D, designed to alleviate gust effects and said to reduce landing speed, has been granted CAA Supplemental Type Certificate SA1-95. System, under development since 1930, is built by "Wings With Springs" Manufacturing Co., Latrobe, Pa.

U. S. Navy ordered an additional number of Beech XKDB-1 medium-performance target aircraft for flight evaluation at Naval Air Missile Test Center, Pt. Mugu, Calif. Follow-on contract is valued at about $1 million and deliveries are scheduled to start in November. During recent trials, an XKDB-1 flew to 38,500 ft. under command control after catapult launching. Engine is a 120-hp. supercharged McCulloch . . . Beech is ferrying Twin Bonanzas over the southern transatlantic route via the Azores, the hop from Gander to Santa Maria being 1,600 mi. over open water.

John G. Kelly, Inc., N. Y. heating specialty manufacturers representatives, purchased 30,000 Cessna airplane, a Model 172, after using it for 25 hr. on a lease plan that initially had four years to run.

New facilities completed at Southern Illinois Airport (formerly Murdale) include runway extension which provides paved strip 4,100 x 100 ft. with additional 1,000-ft. overrun. Expansion was made to accommodate larger twin-engine aircraft.

Ramp Service is a new pocket-size publication for airport line personnel being published by Flight Safety Foundation to provide guides for proper behavior and safe practices. Meeting the arriving airplane, servicing, towing, driving, tips, fire, line signals, proper tiedown procedures, are among topics covered in first issue. Booklets are distributed at cost ($.50) by FSF, 468 Fourth Ave., New York 16, N. Y.

WHO'S WHERE

(*Continued from page 23*)

Changes

Wilson W. Petty, chief engineer, Titanium Fabricators, Inc., Burbank, Calif.

Warren E. Milner, general manager, Hyatt Bearings Division, General Motors Corp., Harrison, N. J. **Martin J. Caserie** succeeds Mr. Milner as manager-Milwaukee operations, AC Spark Plug Division of General Motors, Flint, Mich.

Capt. Steven G. Hawes, director of flight operations-Atlantic, and **Capt. Lyle R. Hincks,** director of flight operations-East (domestic), Trans World Airlines, Inc. Also: **E. J. Minser,** TWA's general manager of passenger service, United States.

Samuel M. Berkowitz, executive engineer-air traffic control, Government and Industrial Division, Philco Corp., Philadelphia, Pa. Also: **Loren E. Gaither,** director of communications engineering.

E. J. Doucet, director-advertising and public relations, Vickers Inc., Detroit.

Alfred H. Grebe, chief engineer, Filtors, Inc., Port Washington, N. Y.

Murray C. Bartlett, manager-product engineering, Aviation Products Division, The B. F. Goodrich Co., Akron, Ohio.

Luther C. Ringer, production manager, Narmco Manufacturing Co., La Mesa, Calif.

Andre Reichel, director-sales and service, Aeronautical Division, Pacific Scientific Co., Los Angeles, Calif.

John J. Wiest, technical director-locknut department, Standard Pressed Steel Co., Jenkintown, Pa.

E. William Place, manager, newly established Missile Products Division, Beckman & Whitley, Inc., San Carlos, Calif.

Herbert G. Schubert, merchandising manager, Cannon Electric Co., Los Angeles, Calif. **V. Fred Rayser** succeeds Mr. Schubert as advertising manager.

Brig. Gen. James W. Andrew (USAF, ret.) will head Northrop Aircraft's liaison office in Colorado Springs, Colo. The office will be established to service USAF's Continental Air Command headquarters.

William C. Stolp, assistant service manager, Chandler-Evans, division of Pratt & Whitney Company, Inc., West Hartford, Conn.

Richard K. Dickson, general manager-West Coast plant (Fullerton, Calif.), Trent Tube Co., East Troy, Wisc.

Dr. Oskar Mattiat has joined the engineering staff of Aerophysics Development Corp., subsidiary of Curtiss-Wright Corp., Santa Barbara, Calif.

Thomas F. Watson, senior field engineer, Amoux Corp., Los Angeles, Calif.

Herbert G. Lindberg, general manufacturing manager, Aircraft Engine Division, Ford Motor Co., Chicago, Ill.

Edward R. Corvey, assistant group executive-business operations, Defense Products Group, American Machine & Foundry Co., New York, N. Y.

Sheldon Matzkin, contract administrator, Consolidated Diesel Electric Corp., Stamford, Conn.

Robert H. Vredenburg, manager-Eastern operations, Marketing Division, American Electronics, Inc., Los Angeles, Calif.

If you are a skilled engineer searching for security and challenging work...

...Rohr is looking for you.
Rohr's large commercial backlog and wide diversification of long-range programs offers reward and permanency to a select group of experienced aircraft *Design and Stress Engineers.*

World's Largest Producer of Ready-To-Install Power Packages for Airplanes

Chula Vista and Riverside, California

ROHR AIRCRAFT CORPORATION

Write Rohr today! We will answer at once and arrange interview at mutual convenience. Address J. L. Habel, Industrial Relations Manager, Rohr Aircraft Corporation, Chula Vista, Calif., Dept 44

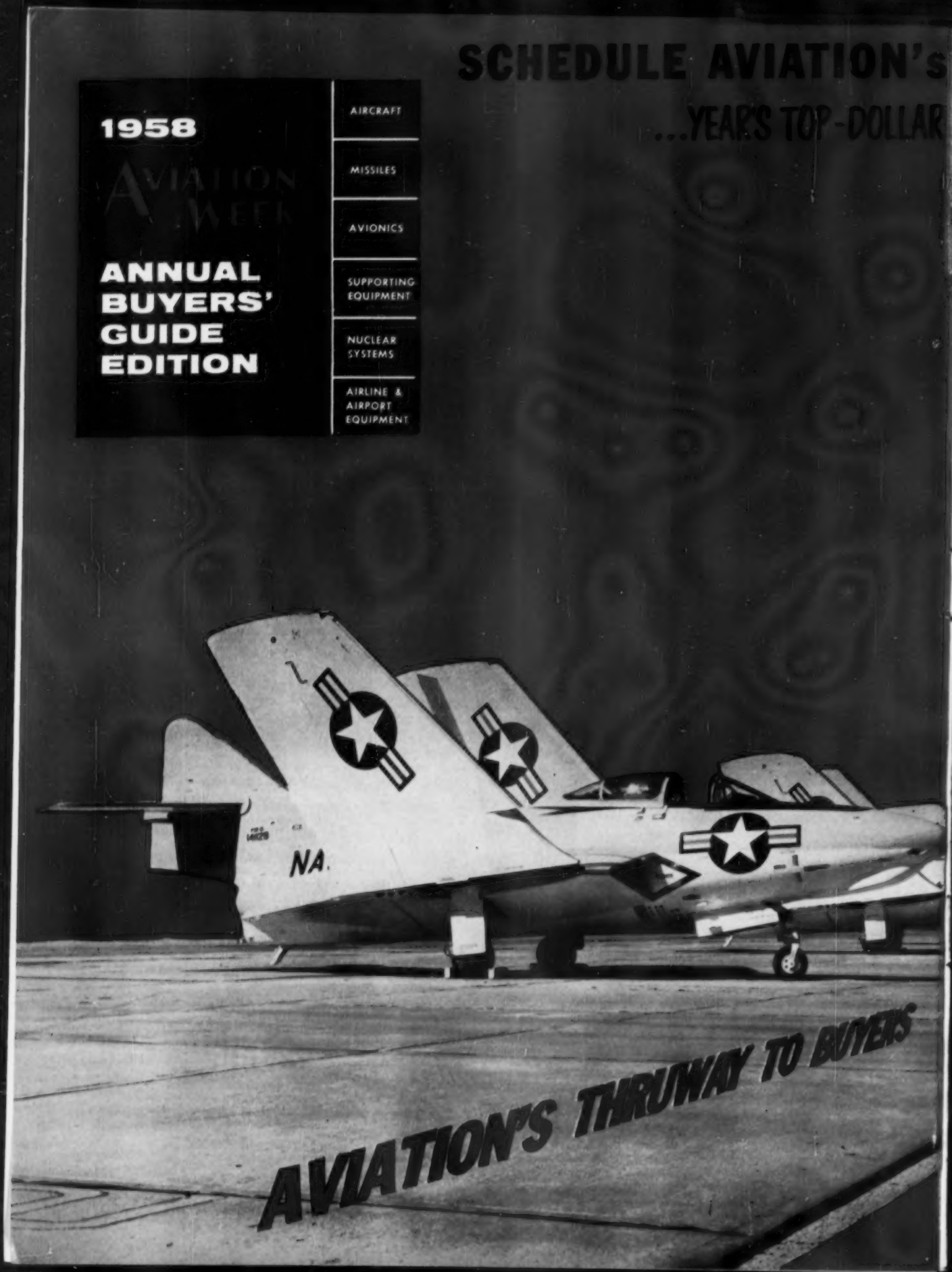
SCHEDULE AVIATION's ...YEAR'S TOP-DOLLAR

1958

AVIATION WEEK

ANNUAL BUYERS' GUIDE EDITION

- AIRCRAFT
- MISSILES
- AVIONICS
- SUPPORTING EQUIPMENT
- NUCLEAR SYSTEMS
- AIRLINE & AIRPORT EQUIPMENT



ONLY BUYERS' GUIDE

DVERTISING VALUE

Dynamic changes – revolutionary new aircraft and powerplant design; rapidly increasing developments in missiles, avionics, rockets, ramjets, chemical and nuclear powerplants; new technology, materials and hardware, shifts in manufacturers and personnel; new buying techniques – call for the utmost attention from engineering-management, purchasing and military people. Published annually in December, AVIATION WEEK Buyers' Guide is depended on throughout world aviation as the only source satisfying the need for full-scale, up-to-the minute answers to year-round purchasing problems.

WHAT's NEW IN AVIATION PURCHASING

AVIATION WEEK editorial teams throughout the U. S. and abroad are now gathering the many thousands of vital purchasing facts that will be included in the over 594 pages of the 1958 BUYERS' GUIDE EDITION. Information-gathering questionnaires are being sent to all aviation manufacturers and suppliers in the U.S. and Canada.

Sections on aircraft, missiles, avionics, supporting equipment, nuclear systems and airline and airport equipment will contain over 50,000 manufacturers' product listings. Latest Air Force, Army and Navy and Airline procurement practices – where to go, whom to see – will be reported in characteristic AVIATION WEEK detail. Special features will include a manufacturers' index, an all-inclusive product index and a comprehensive listing of aviation distributors. These together with many other features assure the greatest possible year-long usefulness for the 1958 BUYERS' GUIDE.

EXCLUSIVE BENEFITS TO ADVERTISERS

AVIATION WEEK Annual Buyers' Guide Edition reaches aviation's largest audience of engineering-management, purchasing, independent research and military people – over 66,186 paid subscribers* throughout the U.S. and 88 different countries. Additional circulation is gained through domestic and foreign extra-copy orders from industry, military and scientific institutions.

Sectionalized Format permits advertisers to position advertisements in the appropriate aircraft, missile, avionics, supporting equipment, nuclear system or airline and airport equipment section. Last year's Buyers' Guide carried over 230 advertisers.

Advertisers' product listings are set in **bold-face type** and buyers are directed to advertisements for additional information through **bold-face** "advertisement page references". A special index of products advertised directs buyers to the product information contained in advertisements throughout the Buyers' Guide.

In addition, advertisements keyed to reader service cards make it quick and easy for buyers to request additional information about products and services advertised.

Year-round selling power and impact of 1957 Buyers' Guide advertising are shown by the over 10,000 reader inquiries received during the 1st six months 1957 from engineering-management, purchasing, and military people throughout the U.S. and abroad. (And they still keep streaming in.) Depth coverage of manufacturers is clearly indicated by the large number of reader service cards coming from vice presidents, purchasing agents, Senior Project Engineers, Design designers, structure, avionic and missile engineers etc., all with the same contractor.

Special discounts on multipage and catalog-type space. Contact your AVIATION WEEK representative who is ready to help you plan your 1958 Buyers' Guide advertising to gain best results.

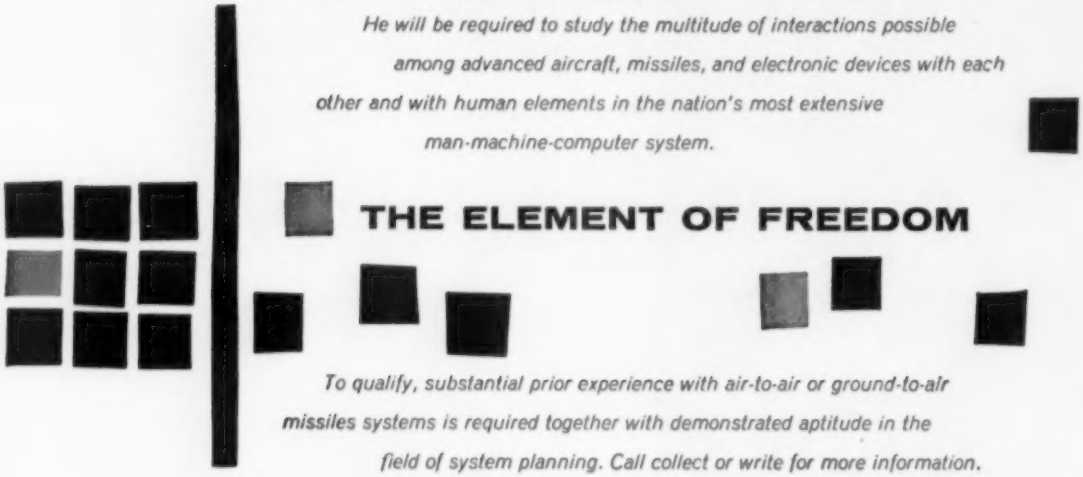
December 1956 ABC 67,210
Current Print Order 70,165

A McGRAW-HILL PUBLICATION
330 WEST 42ND STREET, NEW YORK 36, N. Y.

AVIATION WEEK

Freedom is doing what you like. Some engineers like best to match their wits and skill against difficult technical problems.

This characteristic (or idiosyncrasy) of liking complicated technical problems will be one of the chief qualifications of the engineer we need. He will be required to study the multitude of interactions possible among advanced aircraft, missiles, and electronic devices with each other and with human elements in the nation's most extensive man-machine-computer system.



THE ELEMENT OF FREEDOM

To qualify, substantial prior experience with air-to-air or ground-to-air missiles systems is required together with demonstrated aptitude in the field of system planning. Call collect or write for more information.

System Development Division

The Rand Corporation

2404 Colorado Ave., Santa Monica, Calif. GRanite 8-8293, Extension 53 or 54

11-7

ENGINEERS • SCIENTISTS

3 GENERAL ELECTRIC DEPARTMENTS ENGAGED IN

ADVANCED FLIGHT PROPULSION

WILL INTERVIEW IN

CLEVELAND, OHIO	Sept. 30 - Oct. 1
SEATTLE, WASH.	October 7-8
DALLAS, TEX.	October 21-22
LOS ANGELES, CAL.	November 18-19
WASHINGTON, D. C.	November 25-26

Do you want to learn more of what ESW of 0.24 means for VTOL design? Want more facts on the X405 SP Vanguard 1st stage engine...on the new uses of the J79? You'll get answers to these and other questions from representatives of:

FLIGHT PROPULSION LABORATORY DEPT., Cincinnati, Ohio
JET ENGINE DEPT., Cincinnati, Ohio
SMALL AIRCRAFT ENGINE DEPT., West Lynn, Mass.

Engineering staff positions in these departments are open in:

AERODYNAMICS • THERMODYNAMICS & HEAT TRANSFER
CYCLE ANALYSIS • COMBUSTION • HIGH ENERGY FUELS
FLUID MECHANICS • MECHANICAL ANALYSIS & DESIGN
CONTROLS • FLIGHT TEST PERFORMANCE • MATHEMATICS

GENERAL ELECTRIC

To arrange for a personal interview, please fill out and mail the coupon below. ▼

Mr. Ralph E. Wilson
General Electric Company
c/o Aviation Week, P-5980
Classified Advt. Div.
P. O. Box 12 New York, N. Y.

Please arrange an interview for me with representatives of FPLD, JED, SAED.

DATE DESIRED _____

NAME _____

ADDRESS _____

_____

_____

DEGREE _____

NATIONAL SALES

PROMOTION MANAGER

This position will require top-level aggressive sales executive with experience background in sales promotion, preferably in transportation field.

Must be capable of planning, organizing and directing national sales promotion campaign, and supervising field sales force.

Starting salary $12,000 per year

If interested send detailed resume and photo to:

Frank Roach, Secretary

INDEPENDENT AIRLINES ASSOCIATION

1329 Eye St., N. W. - Washington, D. C.

To EMPLOYERS Who Advertise for MEN:

Frequently, when there are many applicants for a position, only the most promising letters are acknowledged. The other applicants never know whether their letters reached a prospective employer or not. These men often become discouraged, will not respond to future advertisements and even question their bona fide character.

Every Advertisement Printed Is Duly Authorized.

You can help keep our readers interested and get better returns to your advertising in this section if you acknowledge each reply—in plain envelopes, if you wish.

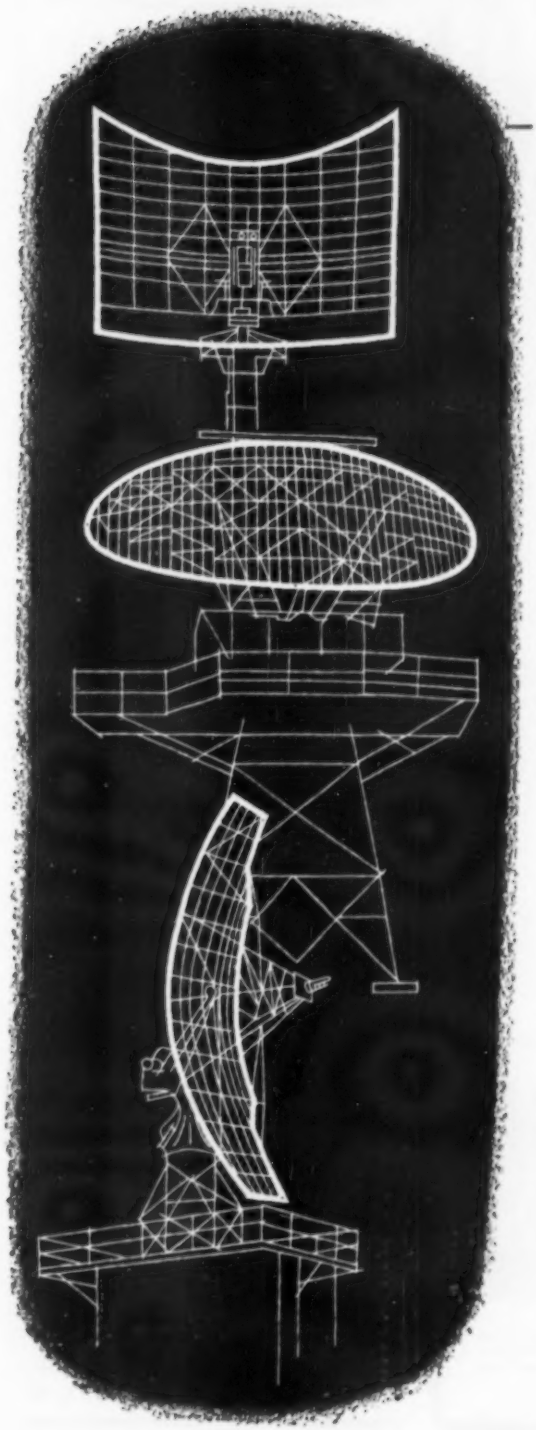
Classified Advertising Division

McGRAW-HILL PUBLISHING CO., INC.

"Put Yourself in his place."

Towers of strength for America's defense

—Another challenge, another opportunity for Goodyear engineers



Wherever the American flag flies, you'll find radar structures like these—on 24-hour alert—ready to warn of an enemy's approach by air or sea.

Built by Goodyear Aircraft for the industry's leaders, radar structures require the utmost in engineering skill and training. They require a specialized knowledge as rare as it is vital. And they're typical of the opportunities that fire the imagination of our engineers at Goodyear Aircraft.

Here you'll find exciting challenges in airship design, electronics, missile components, metals engineering, radomes—the list is broad, the possibilities for achievement almost limitless.

At your disposal are the most modern engineering and research laboratories, including a large computer laboratory. And, needless to add, an environment in which individual expression can flourish, and ideas take wing.

Our continued growth and diversification have required expansion of our engineering staffs in all specialties at both Akron, Ohio, and Litchfield Park, Arizona. If you have faith in your ideas and in your ability to make them work, a rewarding career can be yours at Goodyear Aircraft.

Salaries and benefits are, of course, liberal. And if you wish to continue your academic studies, company-paid tuition courses leading to advanced degrees are available at nearby colleges.

For further information on your career opportunities at Goodyear Aircraft, write: Mr. C. G. Jones, Personnel Dept., Goodyear Aircraft Corporation, Akron 15, Ohio.

They're doing big things at

GOODYEAR AIRCRAFT

Immediate Opportunities for

MISSILE ENGINEERS

Live and work in cool, sunny San Diego

ARMAMENT LAUNCHING & GROUND HANDLING
ELECTRICAL NETWORK STRUCTURES MISSILE SYSTEMS

A creative engineering group is now being formed by Solar at San Diego for a challenging new missile project. This is an exceptional opportunity to rapidly advance your career. And you can enjoy life more *while* you progress... San Diego's climate is the finest in the U.S., and the area offers unmatched cultural and recreational facilities. Solar is a medium-size company (3000 people in San Diego) founded in 1927. Personnel policies are advanced, including a profit-sharing retirement plan. Please send resume of your qualifications and education to Louis Klein, Dept. E-220, Solar Aircraft Company, 2200 Pacific Highway, San Diego 12, Calif.

SOLAR
AIRCRAFT COMPANY

SAN DIEGO
DES MOINES

Send for this new brochure

Write for new brochure, "Your Triple Opportunity at Solar in San Diego"... the complete story on engineering careers at this progressive company and living in San Diego.

LIVE BETTER! The San Diego area offers you every advantage for delightful living. Cool and temperate climate the year around.

Top Professional positions for qualified . . .

NUCLEAR ENGINEERS

- **PRELIMINARY DESIGN**

  Must be experienced in power plant field with nuclear energy as power source. You will be a member of a small advanced planning team having responsibilities in areas of nuclear application to propulsion systems. Should know nuclear technology, experience in propulsion desirable but not necessary. Salary from $10,000 to $12,000 per year.

- **PROPULSION LIAISON**

  Must have technical knowledge to recognize problems and able to take immediate corrective action. You will serve as representative of project manager, responsible for testing at remote testing site. Five years in testing service experience. Half of time spent in travel between development and testing site. Salary from $10,000 to $12,000 per year.

These are two highly responsible management positions, that must be filled immediately. Excellent opportunities for engineers with sufficient background to get into the propulsion field where it counts.

Our midwest location offers big city conveniences, modern schools and shopping, with pleasant suburban living.

Our company is known for stability and liberal benefits. We pay relocation expenses, of course.

We will acknowledge your resume immediately. Write Room A 100

P-6110, AVIATION WEEK
520 N. Michigan Ave., Chicago 11, Ill.

To EMPLOYERS who advertise for MEN:

When there are many applicants for a single position it frequently happens that the only letters acknowledged are those of the most promising candidates. Others may not receive any indication that their letters have even been received by a prospective employer much less given consideration. These men often become discouraged, will not respond to future advertisements, and sometimes question their bona fide character.

Every advertisement printed in the Employment Opportunities Section is duly authorized.

It will help to keep our readers interested in this advertising if you will acknowledge every application received, even if you merely return the letters of unsuccessful applicants with, "Position filled, thank you" written or stamped on them.

We suggest this in a spirit of cooperation between employers and the men replying to employment advertisements.

Classified Advertising Division

McGraw-Hill Publishing Co., Inc.

ENGINEERS EE's ME's PHYSICISTS

You'll Like

GENERAL ELECTRIC'S MARINE AND ORDNANCE RADAR ENGINEERING

Part of the Heavy Military Electronic Equipment Department

THE LAST IN A SERIES OF 3

IF you're looking for that difficult-to-find combination of *Growth Opportunity and Stability*, you'll like Marine and Ordnance. This combination is based upon...

1. *The unexcelled reputation of Marine and Ordnance's past equipments.*
   - (A) ONE, FOR EXAMPLE, HAS HAD A CONTINUOUS IMPROVEMENT PROGRAM COVERING 13 YEARS.
   - (B) ONE OF ITS RADARS IS TO BE FOUND ABOARD EVERY NAVAL SHIP WITH AN AIR INTERCEPT CAPABILITY.
2. *Being anchored to the full resources of General Electric.*
3. *New equipments contracted for.*
   RIGHT NOW THREE PROGRAMS ARE ENTERING PILOT MODEL STAGES, (AS YET NOT FULLY MANNED). PRODUCTION ORDERS ON THESE THREE MODELS ALONE ARE ALREADY IN EXCESS OF $40,000,000.

Regardless of your level of experience there is a project or program to which you can contribute immediately and in which you can grow, whether in specific design or over-all systems engineering.

TELL US ABOUT

your training, experience, job objectives. Expense paid plant interviews including prepaid air transportation (if requested) for qualified engineers.

GENERAL REQUIREMENTS

U.S. Citizenship ★ EE, ME, Physics, Math degree ★ One to five years' experience ★ A desire for technically demanding and stimulating work.

Write in complete confidence to:
MR. GEORGE B. CALLENDER, DEPT. 58-WM
HEAVY MILITARY ELECTRONIC EQUIPMENT DEPT.
GENERAL ELECTRIC
COURT STREET, SYRACUSE, NEW YORK

TOMORROW'S PROBLEMS . . .
. . . TODAY'S CONCERN
at Cornell Aeronautical Laboratory

Air traffic control problems a decade or more distant are of immediate concern at Cornell Aeronautical Laboratory, where research projects devoted to air traffic studies date back to 1949.

As part of C.A.L.'s expanding systems research program, studies are in progress to define the characteristics of future air traffic. The purpose of the studies is threefold: (1) to provide a quantitative base for examination of what will be required of control systems to insure the safe, orderly, and undelayed flow of traffic a decade or more hence; (2) to assess the feasibility of meeting these requirements; (3) to determine the problem areas where research and development effort should be concentrated now. Such studies require merging the skills of specialists in aircraft performance and design, transportation engineering, economics, electronics, and mathematics. These specialists form a team which examines the whole problem as it will confront tomorrow's generation, and recommends the action to be taken today.

Air traffic control studies represent only one area of current research at C.A.L. Varied and complex assignments in such fields as hypersonic studies, transonic wind tunnel operation, flight research, and aeroelastic phenomena are available to capable aeronautical engineers. We invite you to investigate the professional and personal advantages of working at C.A.L. Write today — your inquiry will receive prompt and confidential attention.

WRITE FOR FREE REPORT

The story behind Cornell Aeronautical Laboratory and its contributions to aeronautical progress is vividly told in a 68-page report, "A Decade of Research." Whether you are interested in C.A.L. as a place to work or as a place to watch, you will find "A Decade of Research" both useful and pertinent. Mail in the coupon now for your free copy.

CORNELL AERONAUTICAL LABORATORY, INC.
OF CORNELL UNIVERSITY

W. V. Diefenbach ATCS
CORNELL AERONAUTICAL LABORATORY, INC.
Buffalo 21, New York

Please send me "A Decade of Research."

Name

Street

City Zone State

☐ Please include employment information

EMPLOYMENT PROBLEM?

When you are in need of specialized men for specialized jobs, contact them through an employment ad in a McGraw-Hill Publication.

Management, Engineering, Production, Maintenance, Selling . . . these represent broadly the principal functions in business and industry. And it is principally to the men and executives who fill key jobs in these important divisions that McGraw-Hill publications are directed.

McGraw-Hill Domestic Publications

AMERICAN MACHINIST
AVIATION WEEK
BUSINESS WEEK
CHEMICAL ENGINEERING
CHEMICAL WEEK
COAL AGE
CONTROL ENGINEERING
CONSTRUCTION METHODS AND EQUIPMENT
ELECTRICAL CONSTRUCTION AND MAINTENANCE
ELECTRICAL MERCHANDISING
ELECTRICAL WHOLESALING
ELECTRICAL WORLD
ELECTRONICS
ENGINEERING AND MINING JOURNAL
ENGINEERING NEWS-RECORD
FACTORY MANAGEMENT AND MAINTENANCE
FLEET OWNER
FOOD ENGINEERING
NATIONAL PETROLEUM NEWS
NUCLEONICS
PETROLEUM WEEK
PETROLEUM PROCESSING
POWER
PRODUCT ENGINEERING
PURCHASING WEEK
TEXTILE WORLD

THE MEN YOU NEED ARE THE MEN WHO READ THE

McGRAW-HILL PUBLICATIONS
330 West 42nd St.,
New York 36, N. Y.

REPLIES (Box No.): Address to office nearest you c/o This publication Classified Adv. Div.
NEW YORK: P. O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

SELLING OPPORTUNITY OFFERED

Wanted: Established Sales Representative 200 employee company, catering exclusively to aircraft and electronics industry, desires representation in Mid-West and California, for sheet metal assemblies, stampings, weldments, filters and strainers. RW-6247, Aviation Week.

POSITIONS WANTED

Pilot, commercial single or multi engine. Land/Sea 3300 accident free hours. Naval officer, 39 years of age with instructor/administrative and operational experience. Desire aviation executive or sales flying position. PW-6080, Aviation Week.

Insurance Executive—Law Graduate 37— Family—All phases auto and aviation insurance. Heavy pilot experience. Desires insurance—aviation connection. PW-6114, Aviation Week.

Infrared Systems Specialist. M.M.E. and Physics with substantial experience in basic optical design and optimization of parameters for the development of advanced infrared systems. Recent patent applications in these areas. Additional experience: precision mechanical and electromechanical design, administration and supervision. Desires responsible position, some supervision, with well established company in or close to larger city. Family man, lower forties. PW-6243, Aviation Week.

Co-pilot-Mechanic position wanted. Ten years A&E. Commercial pilot, instrument. Curtis Cleland, 1211 Division, Napa, Calif.

Naval Aviator, Age 24, 1000 Hrs., SMEL & Inst. rating. Desire position as Executive Charter, or Production Test Pilot. PW-6251, Aviation Week.

BUSINESS OPPORTUNITY

Desire active partnership in (or on profit sharing basis) an aircraft radio service. Interested in organizing similar service for distributor. Presently employed as technical representative with commercial and military aircraft experience. BO-6241, Aviation Week.

What is *your* problem?

Competent men for your staff? . . . employment? . . . or are you looking for—or offering—a business opportunity of special interest to readers of this publication? You can get their attention—at small cost—through an advertisement in the Employment Section of AVIATION WEEK.

PROPULSION MEN

Interest and/or experience in power plant evaluation to engage in analysis, design, and tests of propulsion components embracing the entire range of Helicopter and Convertiplane power plant systems. Beginning as well as supervisory positions are available for work in gas turbine engines, compressors, pressure jets, heat-transfer, thermodynamics, combustion analysis, compressible flow, and related activity. Mail experience resume in confidence to:

Technical Placement Supervisor

Box 516, St. Louis 3, Missouri

McDONNELL AIRCRAFT CORPORATION

IN ALL INTERESTS OF AVIATION

If You're Important, you either read

AVIATION WEEK

or you advertise in it, or both.

Qualified Communications—Electronics Superintendent

Write giving experience, salary requirements and enclose recent photo to

Vice President Operations, Bonanza Airlines, Inc, P. O. Box 391, Las Vegas, Nevada

When Answering BOX NUMBERS . . .

to expedite the handling of your correspondence and avoid confusion, please do not address a single reply to more than one individual box number. Be sure to address separate replies for each advertisement.

REGIONAL EXPORT SALES MANAGER

Needed immediately at Cessna to cover Near East, Africa and Europe.

- Knowledge of all or part of above areas is essential
- Must be experienced in Sales and Distribution Management.
- Previous aviation experience desired.
- Will headquarter in Wichita temporarily.

Cessna

Designers and Manufacturers of a complete line of Business Aircraft.

Contact
Professional Placement Supervisor,
Dept. AW,

CESSNA AIRCRAFT COMPANY

5800 East Pawnee Road, Wichita, Kansas

ENGINEERS | DESIGNERS | DRAFTSMEN

STEP FORWARD WITH REPUBLIC'S EXPANDING

GUIDED MISSILES DIVISION

Here are long range programs to enhance your professional talents in a field taking giant strides to leadership. Your best opportunities are with a fast-moving expanding organization well rooted in the art of missiles.

ELECTRONIC ENGINEERS: R&D openings exist for men with experience in missile testing or design of test equipment; design and development (all levels) for electronic and flight control systems on guided missiles; printed circuits; UHF transmitter and receiver circuits; transistor circuits and coding circuits. **DESIGNERS & DRAFTSMEN:** Openings are in electronic packaging and flight control equipment and components. Experience with transistors and printed wiring techniques required. And...you enjoy Republic's outstanding employee benefits program, modern offices and the latest laboratory equipment. Send your resume to Mr. Arnold Bookheim.

GUIDED MISSILES DIVISION
REPUBLIC AVIATION
223 Jericho Turnpike • Mineola, Long Island, N. Y.

Export Representatives in the Aircraft Sales Management Field

If you are a capable pilot, speak Spanish fluently, have sales ability, and are 35 years of age or under, you may have an outstanding future in aviation with a South American assignment from the nation's leading business aircraft manufacturer. You must be free to travel or relocate. The salary range is $5,000 to $7,500. Please send a brief resume with recent photo to Roy A. Kunz, Executive Employment Division, Beech Aircraft Corporation, Wichita 1, Kansas.

USE NATIONAL CLASSIFIED ADVERTISING

for bringing business needs or opportunities to the attention of men associated in administrative, executive, management, sales and responsible technical, engineering and operating capacities with the industries served by McGraw-Hill publications. For advertising rates or other information write:

Classified Advertising Division—McGraw-Hill Publishing Co., Inc.
330 West 42nd Street, New York 36, New York

NEED ENGINEERS?

An employment advertisement in the EMPLOYMENT OPPORTUNITIES SECTION will help you find the engineers you need. It's an inexpensive, time-saving method of contacting competent personnel for every engineering job in the Aviation industry. The all paid circulation of AVIATION WEEK offers you an opportunity to choose the best qualified men available.

For rates and information write:

•

Classified Advertising Division

AVIATION WEEK

P.O. Box 12

New York 36, N. Y.

ACES

OVERHAUL • EXCHANGE • LEASE
ALL P&W ENGINE MODEL'S

R985 - 1340 - 1830 - 2000
R2899 M1 & M2
R2800 C Series

IMMEDIATE DELIVERY

The original M1 & M2 as engineered by ACES copied by many but never duplicated by any. CAA approved repair station—powerplant class 2

Write, Phone or Cable Today
Sales Manager

AIR CARRIER ENGINE SERVICE, INC.
P. O. Box 236, Miami 48, Fla.
Tuxedo 7-2666

PAC

OVERHAUL • SALE • EXCHANGE • LEASE
All Models Pratt & Whitney Engines

R985 R1340 R1830
R2000 R2800

Introducing modernized R2800 engines delivering horsepowers comparable to the R2800-CB. Available immediately or upon scheduled delivery.

Write, Phone or Cable today.

Sales Manager, Engine Division
PACIFIC AIRMOTIVE CORPORATION
2940 North Hollywood Way
Burbank, California
Victoria 9-3481 THornwall 2-5171

WORLD'S LARGEST INVENTORY

C-82 PARTS

Over $10,000,000 worth of New and Serviceable Parts "on the shelf" ready for delivery. Everything from entire wing sections and quick change units to small bolts and nuts available. Prompt quotes.

BETTER C-82's

ONLY AAF Overhauled models available on the market. Stored in ideal climate. 10 day delivery with fresh control surfaces.

STEWARD-DAVIS, INC.
FA 1-3414, P.O. Box 351, Gardena, Cal.

AIRCRAFT HARDWARE

AN—MS—NAS—AN6 Digit-Specials

Bolts - studs - fittings - screws - taper pins - internal wrenching bolts, aluminum, stainless, brass, steel, super alloys. World's most diversified inventory of aircraft standard hardware, also, AN 3436 terminal block assemblies. Air World Manufacturing, Division of Jeb Industries, 6235 Santa Monica Blvd., Los Angeles 38, California. Phone HO 4-7383

EXECUTIVE OPPORTUNITY WITH CESSNA
AS A
REGIONAL SERVICE MANAGER

- Must be able to meet and sell executive management and shop personnel on factory service planning and execution.
- Aeronautical, Machinist or A & E background required.
- Competent pilot essential.

Cessna

If you meet these requirements and are interested in unlimited opportunity with the World's Leading Designers and Manufacturers of Business Aircraft, send your resume and recent photograph to the

Professional Placement Supervisor, Dept. AW,
CESSNA AIRCRAFT COMPANY
5800 East Pawnee Road, Wichita, Kansas
(NO PHONE CALLS, PLEASE)

HIGH-LEVEL OPENING FOR COUNTERMEASURES SPECIALIST

An unusual opportunity in an established company for a technical specialist proficient in ...

PROPOSALS • SYSTEM DESIGN • TECHNICAL LEADERSHIP

STARTING SALARY $13,000

P-6184, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

NAVCO Inc.

Lambert Field
St. Louis, Mo.
Pershing 1-1710

has in stock
A.R.C. Bendix Collins
Sperry Wilcox
Executive Aircraft Radio

DEAL DIRECTLY WITH OWNER

EXECUTIVE
LODESTAR
and VENTURA
BEECHCRAFT
C18S—D18S—E18S
GRUMMAN
GOOSE and
SUPER
WIDGEON
PBY-5A
T-11—T-6G—PV-2
SIKORSKY S-51

AIRLINE
DC-3
CARGO
C-47

All these and more are available from inventory. Buy, sell, lease. Advise us of your requirements. Investigate our diversified plans of aircraft marketing.

TRADE — AYER COMPANY
Linden Airport Linden, N. J.
Hunter 6-7690

When Answering
BOX NUMBERS

to expedite the handling of your correspondence and avoid confusion, please do not address a single reply to more than one individual box number. Be sure to address separate replies for each advertisement.

WORLD'S FOREMOST
LODESTAR
SERVICE CENTER

Inspection	Radar
Maintenance	Interiors
Instrumentation	Engine Change
Modification	Exteriors
Overhaul	Radio

PacAero Engineering Corp.
(Formerly Lear Aircraft Engineering Division)
Santa Monica Airport, Santa Monica, California
Builders of the Incomparable Learstars

DC-4A's
IMMEDIATE SALE

Two (2) DC-4A's formerly operated by Eastern Airlines, plus $235,000 spares, including engine. Package deal, quick sale—$695,000. Financing available. Contact Herrol Bellomy, L. B. Smith Aircraft Corporation, P. O. Box 456, Miami 48, Florida, U. S. A.

EXTRAORDINARY BUY!
For Immediate Sale
1956 TWIN ENGINE
BEECHCRAFT
E18s Serial #BA169
Only 410 engine and airframe hours
Never damaged

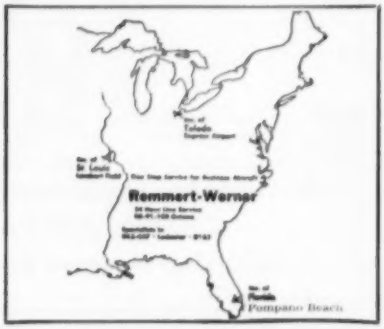
Special features include:
Lear 12 Automatic pilot
Auxiliary wing tanks
Giese Safety Gear
Grimes Beacon
NARCO DME
Dual Instrumentation
ILS Equipment Landing System Radio—NARCO Simplizer and Omnigator. Wing deicers and prop anti-icers. Refreshment Bar and many other extras.
Luxurious interior appointments
Available for installation:
Broadcast receiver for cabin
and low frequency receiver
Will go for **BEST OFFER**

FS-6246, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

FOR IMMEDIATE SALE
OR LEASE
B25J

Presently in use as flying laboratory 2600-29. Engines 65-399 hours, 1688 total time on airframe. Can be used as experimental plane or converted for executive use. Full instrument panel, S200 Janitrol heater, excellent radio, full Ryan exhaust collector ring.

FOR COMPLETE SPECIFICATIONS
CONTACT
R. L. CAINE
GENERAL ELECTRIC COMPANY
FLIGHT TEST CENTER
130 SARATOGA ROAD
SCHENECTADY, NEW YORK
PHONE: FRANKLIN 4-2211,
EXT. 2023 OR 2435



Deal Directly with Owner

HANGARS

U.S. Navy type.
120' clear span
by 200' depth
Doors 120'x28'

All Steel Constructed. Excellent monetary saving and good delivery if you are considering the construction of a hangar of this size.

TRADE-AYER COMPANY
Linden Airport — Linden, N. J.
Hunter 6-7650

SALE—LEASE

C-47-A

00:00 HOURS SINCE O/H • 28 PAY-LOADER TYPE SEATS • COMPLETELY WINTERIZED • 200,000 B.T.U. HEATER • LARGE DOOR—HEAVY GEAR

NATIONAL AREO LEASING
P.O.B. 184 — Miami 48, Fla.

FOR SALE
All-Metal, Five-Place,
High Performance

TRECKER GULL AMPHIBIAN L-1

Powered by two Lycoming 270 hp. engines with Hartzell full-feathering constant-speed props.

Dual controls and brakes; lights; heater; retractable tailwheel and rudder; flasher beacon; engine and windshield covers.

Complete instrumentation. Two DARE 22 channel VHF omni transceivers. ADF, marker beacon, and glide slope.

Exterior Alaska white with red trim. Interior in genuine red and tan leather.

Aircraft was new in February, 1957. Total time only 170 hours.

For immediate sale at exceptionally attractive price.

HOBART A. H. COOK ASSOCIATED
Copiague Road
North Lindenhurst, L. I., N. Y.
(Zahn's Airport)

Immediate Delivery
We stock, overhaul, and install

PRATT & WHITNEY	WRIGHT
R1830	R1820
-75, -92, -94	-202, -56, -72

R985 R1340 R2000
and our most popular DC3 engine
R1830 - SUPER - 92

ENGINE WORKS
INC.
Lambert Field Inc. — St. Louis, Mo.

AIRCRAFT DISPATCHERS SCHOOL
NOW AVAILABLE TO QUALIFIED APPLICANTS. CAA APPROVED
FOR DETAILS WRITE
AIRLINE DISPATCHERS
MEACHAM FIELD — FT. WORTH, TEXAS

TWO UNUSUAL OPPORTUNITIES—OWNER SEEKING REASONABLE OFFERS

Douglas DC-3 and Beechcraft D-18S. Both with luxury executive-type interiors complete with galley, lavatory, tables, large storage space and scores of other "extras". Complete dual instrumentation, full radio equipment and auto pilot. DC-3 seats 12; D-18S seats 4. Each airplane is in perfect mechanical condition. For complete details, contact:

William C. Weld Associates, 981 Fifth Avenue, New York 17, New York. RU 7-2050.

AN HARDWARE & FITTINGS
Stainless, Aluminum, Brass, Steel. All sizes—immediate delivery from world's largest shelf stock. Buy direct from manufacturer. Lower prices—quicker service. Send for free wall charts showing complete line of AN Fittings.

COLLINS ENGINEERING CORPORATION
9950 Washington Blvd. — Culver City, California

C-47'S FOR SALE DC-3'S
ALSO
REPAIR OVERHAUL MODIFICATION
VOLITAN AVIATION
INC.
12820 Pierce St. — Pacoima, Calif.
Phone EM-9-1283

IMMEDIATE DELIVERY
C-47 B

R 1830-92 eng. Total time 1415 hrs. Manuf. 1945. Ser. No. 32867. Completely overhauled zero time. New CAA Cert. of Airworthiness. Can be inspected in New York City area.

FS-6005, Aviation Week
Class. Adv. Div., P. O. Box 12, N. Y. 36, N. Y.

SUPER CUSTOM APACHES
FOR SALE OR LEASE
1955 TT 585; 1956 TT 330; 1957 TT 78. 3 very fine planes.
GEORGE H. BAILEY COMPANY, INC.
3508 Quimby Arcade - Ft. Wayne, Ind.

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, SEPTEMBER 30, 1957

A.C. ELECTRONICS DIV., GENERAL MOTORS CORP. 98
Agency—E. H. Brown Advertising
AIR FRANCE 95
Agency—Buchanan & Company, Inc.
AIRWORK CORPORATION 111
Agency—Gene Wyble Advertising
AMERICAN WELDING & MFG. COMPANY 10
Agency—The Bayless-Kerr Co.
AMPHENOL ELECTRONICS CORPORATION 11
Agency—Burton Browne Adv.
ARMCO STEEL CORPORATION 100-101
Agency—N. W. Ayer & Son, Inc.
AVIATION WEEK 115, 118, 119
AVCO MANUFACTURING CORPORATION, LYCOMING DIVISION 36
Agency—Benton & Bowles, Inc.

BETHLEHEM STEEL COMPANY 14
Agency—Jones & Brakeley, Inc.

CALIDYNE COMPANY, THE 55
Agency—Meissner & Company, Inc.
CESSNA AIRCRAFT COMPANY 86
Agency—Gardner Advertising Company
CLIFTON PRECISION PRODUCTS CORP. 26
Agency—Ivey Advertising Company
COLE ELECTRIC COMPANY 56
Agency—Taggart & Young, Inc.
CRAIG SYSTEMS, INC. 6
Agency—Lawson Randall Adv., Inc.
CURTISS WRIGHT CORPORATION 7
Agency—Burke Dowling Adams, Inc.

DEXTREX CHEMICAL INDUSTRIES, INC. 57
Agency—Howell & Young Adv., Inc.

EDGEWATER STEEL COMPANY 107
Agency—Downing Industrial Advertising, Inc.
ELASTIC STOP NUT CORPORATION 94
Agency—G. M. Basford Company
ELECTRO SNAP SWITCH & MFG. COMPANY 16-17
Agency—Stoetzel & Associates, Inc.
ESSO STANDARD OIL COMPANY 46
Agency—McCann Erickson, Inc.
EX-CELL-O CORPORATION 13
Agency—Holden-Chapin-Larue, Inc.
ETHIOPIAN AIRLINES, INC. 129
Agency—St. Georges & Keyes, Inc.

FENWAL INC. 65
Agency—James Chirtz Company
FOOTE BROTHERS GEAR & MACHINE COMPANY ..... Second Cover
Agency—Ross Llewellyn, Inc.

GARRETT CORPORATION—AIR CRUISERS DIVISION 44
Agency—J. Walter Thompson Company
GENERAL PRECISION LABORATORY, INC. 62-63
Agency—Geer, DuBois & Company, Inc.
GOODYEAR TIRE & RUBBER COMPANY 3
Agency—Kudner Agency, Inc.

HEINEMANN ELECTRIC COMPANY 73
Agency—Thomas R. Sundheim Adv.
HEXCEL PRODUCTS COMPANY 8
Agency—Peter Hurst Advertising Inc.
HOFFMAN LABORATORIES CORPORATION 74-75
Agency—D. R. Miner
HOLLEY CARBURETOR COMPANY 78
Agency—Holden, Chapin, Larue, Inc.
HYDRO-AIRE INC. 66-67
Agency—Gaynor, Coleman, Prentis & Varley, Inc.

JOHNS MANVILLE PRODUCTS 106
Agency—J. Walter Thompson Co.

KELSEY HAYES COMPANY 35
Agency—Zimmer, Keller & Calvert Inc.

LAVELLE AIRCRAFT CORPORATION 5
Agency—The Roland G. E. Ullman Org.
LEACH RELAY COMPANY, DIVISION OF LEACH CORPORATION ..... Third Cover
Agency—Hixson & Jorgensen Inc.
LEBANON STEEL FOUNDRY 59
Agency—Howard E. Marshall Adv.
LEWIS ENGINEERING COMPANY, THE 96
LINDE COMPANY—DIV. UNION CARBIDE CORPORATION 68
Agency—J. M. Mathes, Inc.
LOCKHEED AIRCRAFT CORPORATION 48-49
Agency—Foote, Cone, Belding Adv.

MACWHYTE COMPANY 20
Agency—Needham, Louis & Brorby, Inc.
MANNING, MAXWELL & MOORE, INC. 97
Agency—Fuller, Smith & Ross, Inc.
MARQUARDT AIRCRAFT COMPANY 104-105
Agency—Heintz & Company, Inc.
MAXSON CORPORATION, THE W. L. 83
Agency—Engineered Advertising
MILLER ELECTRIC MFG. COMPANY, INC. 77
Agency—M & M Advertising, Inc.

NORTH AMERICAN AVIATION, INC. 84
Agency—Batten, Barton, Durstine & Osborn, Inc.
NORTHROP AIRCRAFT, INC. 116
Agency—West Marquis Inc.

OAKITE PRODUCTS, INC. 85
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.

PERKIN ELMER CORPORATION—ENGINEERING & OPTICAL DIVISION 92
Agency—G. M. Basford Company

QUAKER RUBBER DIVISION—H. K. PORTER COMPANY, INC. 112
Agency—Ruthrauff & Ryan, Inc.

RAYTHEON MANUFACTURING COMPANY 99
Agency—Donahue & Coe, Inc.
REACTION MOTORS, INC. 93
Agency—The Aitkin Kynett Co.
ROBINSON AVIATION, INC. 52
Agency—Platt, Byson & O'Donnell, Inc.
RYAN AERONAUTICAL COMPANY 18, 55
Agency—Batton, Barton, Durstine & Osborn, Inc.

SERVOMECHANISMS, INC. ..... Fourth Cover
SILICONES DIVISION—UNION CARBIDE CORPORATION 24
Agency—J. M. Mathes, Inc.
SOLAR AIRCRAFT COMPANY 80
Agency—The Phillips Ramsey Company, Inc.
SPENCER THERMOSTAT DIV., METALS & CONTROLS CORPORATION 87
Agency—Sutherland-Abbott, Adv.
STEWARD WARNER CORPORATION—ELECTRONIC DIVISION 15
Agency—The Buchen Company
SUNDSTRAND MACHINE & TOOL COMPANY 88-89
Agency—Howard H. Monk & Associates

THERM-ELECTRIC METERS COMPANY, INC. 83
Agency—Taylor M. Ward, Inc.
TRENT TUBE COMPANY 60
Agency—G. M. Basford Company

UNION CARBIDE CORPORATION 24, 68
Agency—J. M. Mathes, Inc.

VICKERS, INC. DIVISION OF SPERRY RAND CORPORATION 54
Agency—Witte & Burden Adv.
VICKERS ARMSTRONG LTD. 42
Agency—McCann Erickson Inc.
VOI-SHAN MFG. CO. 9
Agency—Gaynor Colman Prentis & Varley, Inc.

WEBER AIRCRAFT CORPORATION 4
Agency—Byron H. Brown & Staff
WESTERN GEAR CORPORATION 12
Agency—Ruthrauff & Ryan, Inc.
WYMAN-GORDON COMPANY 22
Agency—John W. Odlin Company, Inc.

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 117-227
EDUCATIONAL
Schools 128
EQUIPMENT
(Used or Surplus New)
For Sale 127-128

ADVERTISERS INDEX

Air Carrier Engine Service Inc. 127
Airline Dispatchers 128
Air-World Manufacturing 127
Bailey Co., George H 128
Beech Aircraft Corp. 126
Cessna Aircraft Co. 125, 127
Collins Engineering Co. 128
Cook Associates, Hobart A. H. 128
Cornell Aeronautical Laboratory 124
Engine Works 128
General Electric Co. 120, 122, 123, 128
Goodyear Aircraft Corp. 121
Horton-Horton 128
Independent Airlines Assoc. 120
McDonnell Aircraft Corp. 125
National Aero Leasing Corp. 128
Navco 127
PacAero Engineering Corp. 128
Pacific Airmotive Corp. 127
Remmert Werner Inc. 128
Republic Aviation Corp. 126
Rohr Aircraft Corp. 117
Solar Aircraft Co. 122
Smith Aircraft Corp., L B. 128
Stewart-Davis Inc. 127
System Development Div., Rand Corp. 120
Trade-Ayer Co. 127-128
Vollitan Aviation Inc. 128
Weld Associates, Wm. C. 128

THE
MODERN AIR ROUTE
TO EAST AFRICA

• Six International Convair Flights Weekly between Athens and Addis Ababa via Cairo, Khartoum, Asmara and Port Sudan.

• Frequent connections to Aden.

COMING IN 1958!
DC-6B Service between Athens and Addis Ababa via Cairo
NEW SPEED, COMFORT, LUXURY FOR EAST AFRICA TRAVEL!

የኢትዮጵያ አየር መንገድ
ETHIOPIAN AIRLINES
THE WONDERLAND ROUTE

General Agents in United States and Europe TWA

Men on the Move

Now available
in a *new edition* . . .
with *new figures.*

This popular booklet points up the important sales problem of personnel turnover in industry. Out of every 1,000 key men (over a 12-month period) 343 new faces appear . . . 65 change titles . . . 157 shift . . . and 435 stay put. These figures are based on average mailing address changes on a list of over a million paid subscribers to McGraw-Hill magazines.

Write us for a free copy

Company Promotion Department
McGraw-Hill Publishing Co., Inc.
330 West 42nd Street,
New York 36, New York

LETTERS

Implication Corrected

Due to extended absence from office, Capt. Robson's Cockpit Viewpoint in the Sept. 9 issue of your excellent magazine was not brought to my attention until today. Have no comments on Ace's opinion as expressed in the column but request you correct the implication in the column that Aeronautical Radio, Inc. "instructs" manufacturers. Manufacturers as well as airlines participate in the preparation of Arinc characteristics and when issued they are for the optional use of either. If it is true that a manufacturer is instructed to comply, such instructions would have to come from the individual airline customer, not Arinc.

May we have your permission to reproduce the column for the information of our AEEC members?

William T. Carnes, Jr., Chairman
Airlines Electronic Engineering Committee
Aeronautical Radio, Inc.
Washington, D. C.

Pilot's Opinion

I am an airline pilot and, like so many other fellow pilots, would like to publicly state that I neither agree with nor condone Capt. Specht's conduct. It is obvious that the whole issue can be summed up as a personal problem of his, but the consequences of his actions were far more reaching than he thought.

The ALPA is defending pilot Specht not because he was right in his actions but because we pilots need to defend the right of a pilot in exercising his emergency authority. This authority is granted to us so that we may fly our passengers in safety and govern any situation that may come up in an emergency. This authority is not to be abused by certain individuals who then expect the other pilots to back up their actions.

As in any business there are a few selfish and short sighted individuals who place themselves above their responsibilities, and in the case of a pilot charged with the safety of so many others, to fly his aircraft in a reckless manner just to prove a point and show them (the controllers) who is flying the aircraft, is uncalled for.

Mr. Burton is to be congratulated on his broadmindedness in presenting the viewpoint of the Air Traffic Control Assn. (AW Aug. 26, p. 138). We pilots must get along with our controllers and through team work produce a more efficient transport operation. Pilot Specht and others like him represent their airline to the public, and through publicity they bring ill feeling toward the pilot group and their airline. If they can't seem to get along with others and bring their animosities into their work they need not expect the backing of their *fellow* pilots.

I hope that others will accept the fact that the majority of the pilots are doing their job and are interested in delivering their passengers to their destination in the fastest time and in a safe way. The pilot group must find a way of ridding themselves of these few who do so much to undermine their occupation if the ALPA will do nothing.

TWA Captain
San Francisco, Calif.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address Letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Defense Budget

Re Robert Hotz's editorial in the Aug. 26 issue entitled "Are We Really Saving Money?"—although I read Mr. Hotz's column with great interest and relish, I take exception to his comments about the defense budget cuts and their adverse effects upon our future security.

My entire working career has been spent in the engineering field, associated with defense projects of one kind or another and though I believe that a defense budget is an essential part of our economy and required for national security, it should be provided for and administered in a manner consistent with good management and sound economic practices. The performances by the various services in the fields of missiles, manned aircraft and various R&D programs has been nothing short of chaotic. What with service rivalries, and the shenanigans of the Pentagon boys it's not at all surprising that we have duplication, triplication and even quadruplication of planes, missiles and other supporting equipment. They've been stumbling and fumbling long enough under the guise of "National Defense," and I for one am happy to see some effort directed toward controlling the indiscriminate squandering of taxpayers' money. So, let's not get carried away and start paying lip service to the hackneyed cries of "grave Communist threat," etc., etc., now that the Congress has finally put some teeth into its decisions and is beginning to lower the boom on some of these nondescript R&D programs and other wasteful expenditures.

At this point, I really don't know if we're really saving money, but it will at least make some of the crazed money spenders more economy minded and hopefully result in a more selective and controlled defense program.

Ernest Meder
Syosset, N. Y.

ICBM Awareness

Congratulations on your editorial "Facts and Fiction on the ICBM" in the Sept. 2 issue of Aviation Week. Although the editorial comment is most enlightening, it still leaves many problems. The greatest problem being that the general public is not aware of the facts that your editorial and news comments of the May 20 issue of Aviation Week contained. Unless able to read your magazine, the general public is either uninformed or misinformed.

The public, in general, would sum up its knowledge of the ICBM development in the following phrase: "We do not know for sure whether the Soviets have or have not as yet successfully fired an ICBM. We know that someone in the United States knows whether or not the United States has successfully fired an ICBM."

The lack of information contained in the above double talk, plus the general negative attitude of the aircraft industry, leaves the public bewildered. A leading aircraft executive was quoted the other day as follows: "Belt tightening had to come and it is time industry and the public faced up to actualities. The public thinks there is too much defense; they are only interested in austerity." This would lead many to believe that the aircraft industry itself has accepted a policy of complacency. The result is not only a cutting of the defense budget, but a cutting of the long range technological planning and philosophy.

Technological development is not only concerned with the aircraft industries who have been unfortunate in making headlines due to cut-backs or layoffs. Many industries involved within the overall aircraft field have not had cut-backs and have long range plans for development requiring increasing numbers of scientists and engineers this year and for the next generation.

I hope that through your editorial you may influence someone within our industry to forget the scare tactics and the belt tightening and take a positive stand in facing the problem that good scientists will be needed today and tomorrow, and that more people should be encouraged to enter engineering schools and to seek employment in stable industries, many of whom are still in the aircraft business.

R. L. Auten
Stratford, Conn.

Helicopter Errors

There are two errors in your presentation of our pilotless helicopter (AW Sept. 2, p. 69).

Error number one is where you say the pilotless helicopter is a Kaman HOK. Actually it is a Kaman HTK.

Error number two, a really serious error, is where you say the robot is "controlled by radio signals from ground through cable." The robot is controlled by radio signals, period. The *rope* (it is not a cable) attached to the robot and to the ground was there for safety purposes during the first pilotless flight. This was explained in our news release picture caption.

The Kaman robot helicopter, a joint Army-Navy program, has accumulated several hundred hours of radio controlled flight time since its first flight in 1954. This was done with a safety pilot aboard. On July 30, 1957, the Kaman robot helicopter made the world's first pilotless helicopter flight. The photo reproduced in your Sept. 2 issue was taken during that flight.

Charles Kirchner
Vice President, Public Relations
The Kaman Aircraft Corp.
Bloomfield, Conn.

LEACH

400-CYCLE POWER

GUARANTEES UNFAILING RELIABILITY

You get built-in reliability guaranteed to stay within specifications indefinitely. No electron tubes, no moving parts other than rugged rotor and contactors. Magnetic amplifier controlled. Just plug it in and forget it. Contact your nearby Leach office or representative.

There's a custom-built Leach motor-generator set for every 400-cycle application. Write for Bulletin, *400-Cycle Power.*

LEACH *CORPORATION / INET DIVISION*

4441 So. Santa Fe Ave., Los Angeles 58, California • District Offices and Representatives in Principal Cities of U. S. and Canada

E B POWER
UNIVERSITY MICH
313 N 1ST ST
ANN ARBOR MICH

Timesaver + Spacesaver = LIFESAVER

Keeping pace with the development of modern, high-performance fighter aircraft, Wright Air Development Center has created a whole new concept in instrumentation.

Old fashioned clock-type dials which take time to read and interpret, and which waste valuable space, are being replaced by what WADC calls "whole panel instrumentation." This concept presents flight information in a relatively few, integrated displays in directly usable form, saving time and space. And, it is now possible to place command information before the pilot, showing him what he should be doing and how to do it.

Servomechanisms, Inc. is proud to cooperate with WADC and Air Materiel Command in applying its proven design experience to the development of several of the new whole panel instruments. One, for example, provides extremely accurate altitude and rate-of-climb information on vertical scales, thereby relating information to a common horizontal line—a reference integrated with companion instruments. For additional data, write to:

SERVOMECHANISMS SMI INC.

SUBSYSTEMS GROUP

GENERAL OFFICES: 12500 Aviation Boulevard, Hawthorne, California
PLANTS: Westchester, California • Hawthorne, California • Westbury, L. I., N. Y. • Garden City, L. I., N. Y.

The products of SMI are available in Canada and throughout the world through Servomechanisms (Canada) Limited, Toronto 15, Ontario.